MODERN PLASTICS

November 1957

page 106 **Use plastics tote boxes for greater efficiency, higher profit**

page 99 **How the revolution in plastics extrusion affects you**

MOLDERS like Durez diallyl phthalates because they handle well with little or no pampering in compression or transfer molding and in preheating. Existing molds can usually be used without modification.

ELECTRICAL ENGINEERS have found in diallyl phthalates a hitherto unavailable solution to problems involving retention of insulation resistance where performance is expected under high humidity and elevated temperature conditions. Dielectric constant and volume and surface resistivity after prolonged conditioning are particularly notable.

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MODERN PLASTICS*

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Geon makes a triple play in this automotive upholstering material. The backing is cardboard coated with Geon latex; padding is economical nonwoven fibers bonded with Geon latex; exterior is fabric coated with Geon. The assembly is heat sealed.

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Classic decorated porcelain simulated for the first time in

NEW MELAMINE Schlitztap

NEW "SCHLITZTAP" consists of three melamine parts—handle collar, color band, and decorated section. These are assembled on a threaded aluminum rod and held between an anodized aluminum shank and crown. This striking draught beer sales aid stands a handsome 12" high, carries two gay, five-color village street scenes. It looks like the finest bone china.

"Fused-in" decorations now possible on complex shapes, says Chicago Molded... and here's how it's done:

The design and production of the beautiful new "Schlitztap" is the result of more than two years of intensive research by the Jos. Schlitz Brewing Co., and by Hammer Bros., Inc. A solution to the complex problems involved in molding the tap handles was provided by Chicago Molded who engineered and molded the plastic parts.

A milestone in plastics technology, the "Schlitztap" represents the first time that a compound curved melamine surface has been decorated on a production-line basis. And with this type of decoration, the design is fused right into the melamine. It's virtually indestructible—immune to perspiration, scratching, staining or chipping.

Paves way for new applications. Most important, the "Schlitztap" represents a breakthrough for plastics into the field of decorated ceramics. It suggests parts ranging from decorated containers and giftwares, to lamp bases and door knobs—all made of beautiful, break-resistant melamine.

How it's done. Among the technical molding problems overcome by Chicago Molded was appearance of bubbles on the decorated surface, mottling of colors, and "burning out" of the pastel tones. Using a dual cycle operation, each piece is molded in a horizontal position on a 170-ton transfer press. During the first phase, melamine is forced into the die and allowed to pre-cure. The mold is then opened for positioning of two melamine foil overlays. Then there's a final curing cycle and the decoration becomes an integral part of the completed handle.

Whatever your plastic molding needs, you'll find it pays to call in Chicago Molded. CM engineers keep abreast of the progress in plastics, often *create* that progress to help you make your product more saleable. *That's why 66% of our business comes from firms we've served for over 20 years.*

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Editorial

Profit squeeze in plastics

The economic record for the second quarter of 1957 is now in hand and information on the third quarter is dribbling in.

The trend pattern, while far from clear, shows a steady income rise, a recent record rate of retail sales, and a very spotty situation in manufacturing.

Since retail sales are largely from inventory, a static situation in factory output in many industries has produced a profits squeeze in manufacturing.

Profits per unit of manufacture are based on material costs, labor costs, and the cost of money. Labor costs have been rising steadily; so have most material costs; both long term and short term capital is expensive to borrow today. Obviously the end-product manufacturers—in automobiles, home appliances, electronics, etc.—are going to have to do four main things, or suffer:

1. Resist wage increase demands for the next few months.
2. Make sure that when capital is acquired it is put into processes that will minimize the labor content of the product.
3. Re-evaluate all materials and components from a standpoint of costs.
4. Redesign for lower costs.

Plastics, which have come down in price in the face of increases in almost all other materials, offer end-product manufacturers a chance of attaining at least a softer squeeze between costs and profits. They lend themselves to automation; they are completely available; in product redesign a single plastics component can frequently replace an assembly of other materials; they seldom require finishing; and they are light in weight, which makes for savings in transport.

While this situation represents an opportunity to the plastics industries, it must be observed that those industries themselves at both material maker and custom processor level are in a cost-profit squeeze.

It is heartening to have end-user industries looking to plastics to help ease the cost-profit squeeze, but the fact is that, if some plastics materials go much lower in price, the material makers will find themselves with little or no return on invested capital and processors will find their profits peanut size.

The plastics industries, which have made every conceivable effort to keep their costs and prices down, in helping end-user industries to soften their cost-price squeeze cannot allow themselves to be further squeezed.

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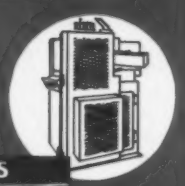

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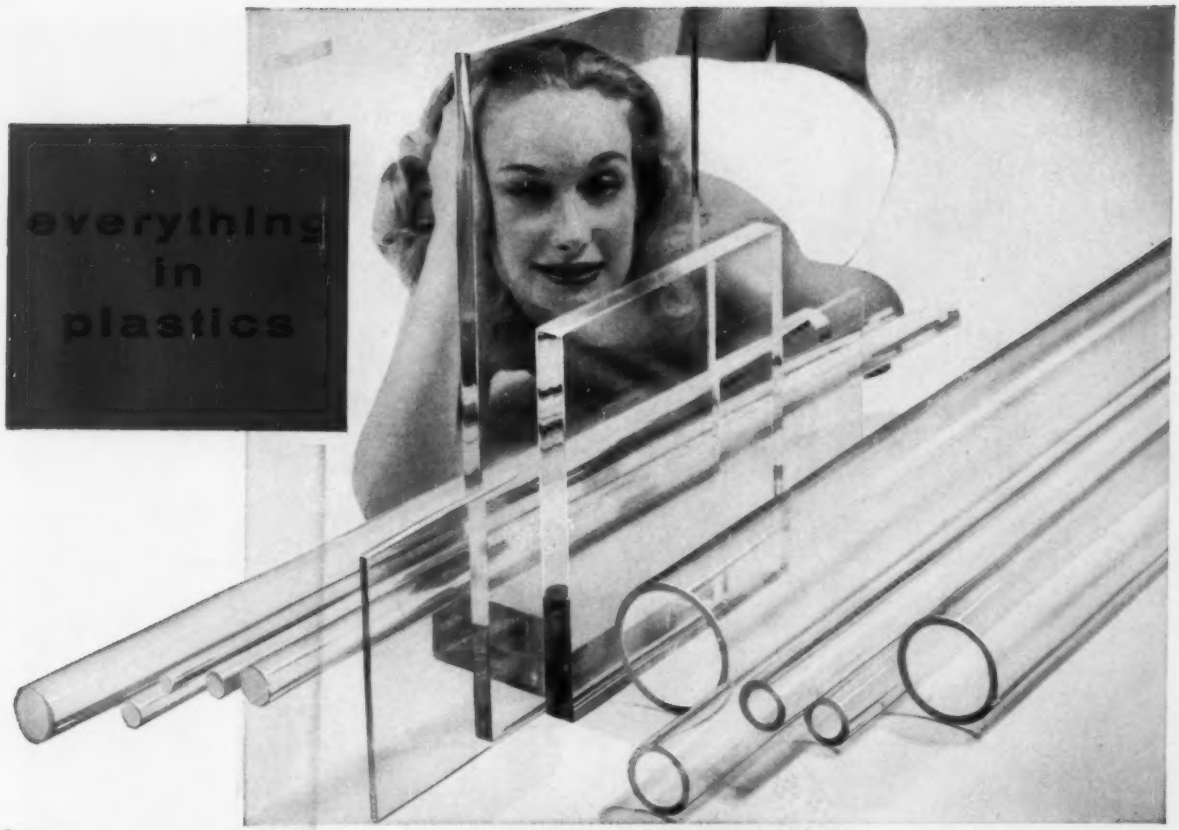

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CRUCIBLE CSM 2 mold in press at Pro-phy-lac-tic Brush Co., Florence, Mass. The mold, built by Eagle Tool & Machine Co., Hillside, New Jersey, produces vegetable pans for Hotpoint refrigerators.

why **CRUCIBLE CSM 2**

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One reason is that CRUCIBLE CSM 2 is always uniform in structure and composition. It's got to be. For the quality of every *heat* is controlled by Quantometer analysis . . . and every *piece*, regardless of size, is ultrasonically inspected. This means superior machining and polishing characteristics.

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Vacuum-forming with acetate starts a 3-point program rolling for Holley Carburetor and Dealers

Another first for Holley Carburetor—the first vacuum-formed package for automotive parts—a unique package that not only protects delicate Contact Set units, but also facilitates their merchandising, builds customer interest and confidence.

Celanese acetate plays an important role in the success of this 3-point packaging-merchandising operation:

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2. And because Celanese acetate prints clearly, it makes possible the identification of each package with its part number. This makes inventory-taking easier, eliminates many stocking problems.

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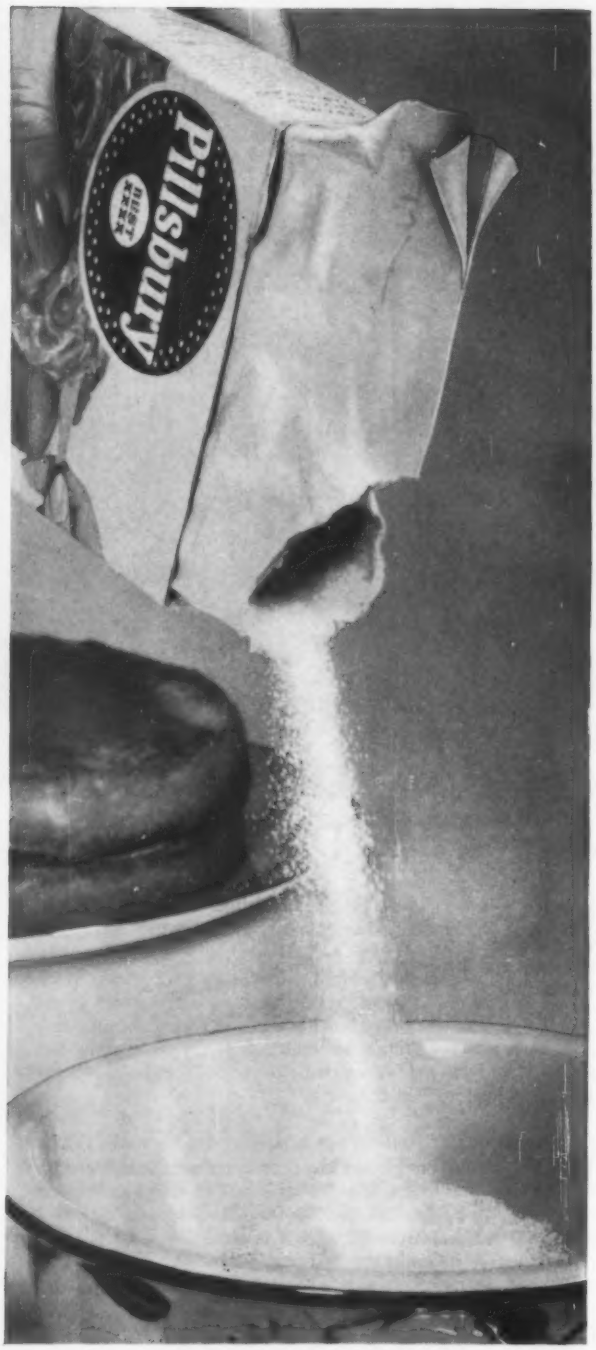

FROSTING MIXES in packages coated or laminated with an ALATHON are assured of freshness and flavor protection until used. Impermeable ALATHON keeps moisture from powdered products... prohibits lumping and caking. (Coating of an ALATHON for Pillsbury Mills, Inc., Minneapolis, Minn.)

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Wire and cable protected by insulation and jacketing of

polyethylene resin for your needs

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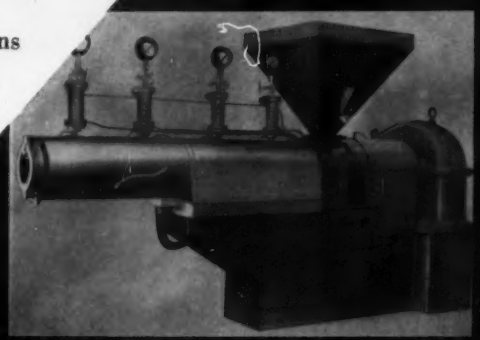
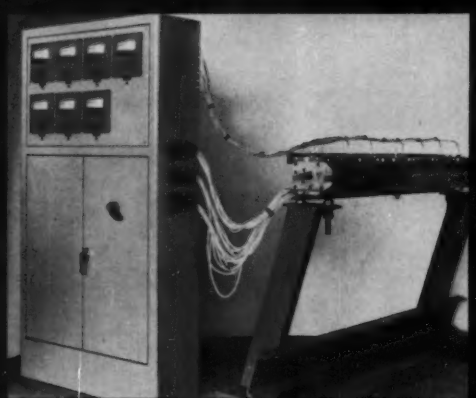
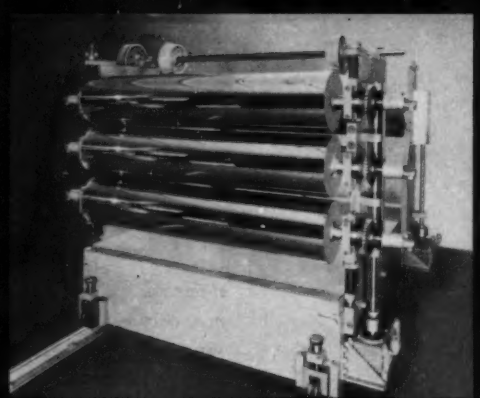


EXTRUDER: Available with or without "Willert Temperature Control" system. Willert system provides automatic, balanced temperature levels. Egan extruders, with patented features, designed to meet any requirements.



SHEET EXTRUSION DIE: Manifold type, adjustable die opening for thicknesses to ¼", completely pre-wired temperature control panel.



SHEET FINISHING UNIT: Three highly polished, chrome plated, double shell finishing rolls; rubber covered pull rolls, variable speed drive.

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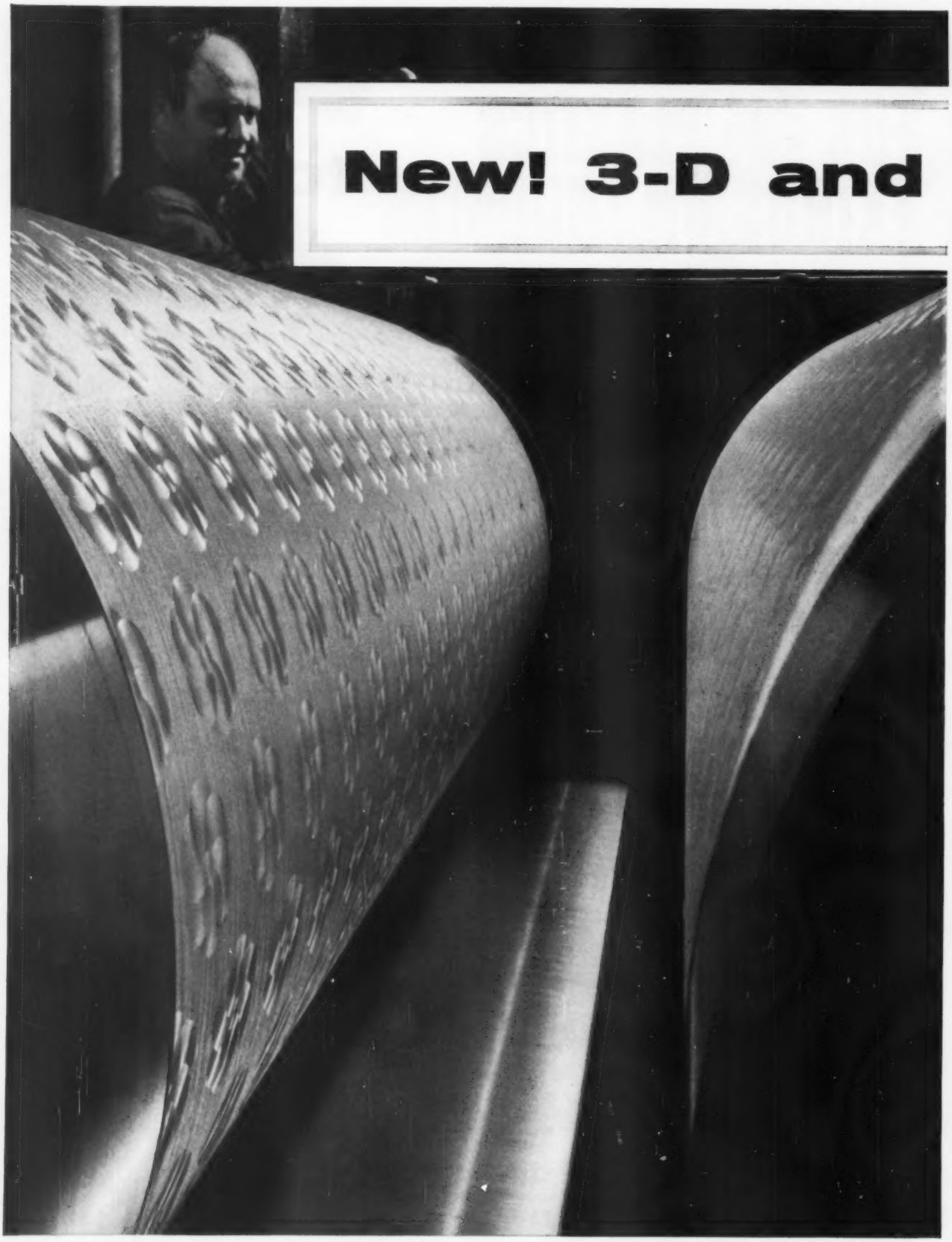

Vista Vinyl made by Harte & Co., Inc., New York, N. Y.—Manufacturers of famous Wataseal Vinyl Film.

Vista Vinyl, Wataseal—T.M.'s Harte & Co., Inc., New York, N. Y.

fluorescence, too

Coming off the calender at left is a doubly new kind of vinyl film, called Vista Vinyl. Its first mark of distinction is a striking, three-dimensional appearance. Its second outstanding characteristic is a never-before-achieved fluorescent color.

The three-dimensional effect is obtained through a unique method of embossing which takes into consideration Fresnel's theory on the absorption and reflection of light. The distinctive color is achieved through extra-careful compounding and processing of the heat-sensitive fluorescent pigments.

A major role in the successful production of this unusual film is played by PLIOVIC. Because it is dry blending and fuses at a relatively low temperature, PLIOVIC processes readily to minimize the effects of heat degradation on both resin and pigment. It also embosses easily and sharply and provides excellent heat sealability. And these processing advantages are accompanied by good heat and light stability plus good, general physical properties.

The particular PLIOVIC used in this three-dimensional film is one of a family of vinyl resins designed to give you improved processing and/or end properties. Included in the current line are resins of both the dry-blending and heat-mixing type which display definite advantages in the calendered, extruded, electrical and dispersion fields—and more are on the way.

A simple way to keep posted on the PLIOVIC resins is to be sure you are getting the latest *Tech Book Bulletins*. They're yours, just by writing to:

Goodyear, Chemical Division, Akron 16, Ohio.

PLASTICS DEPARTMENT

CHEMICAL GOODYEAR DIVISION

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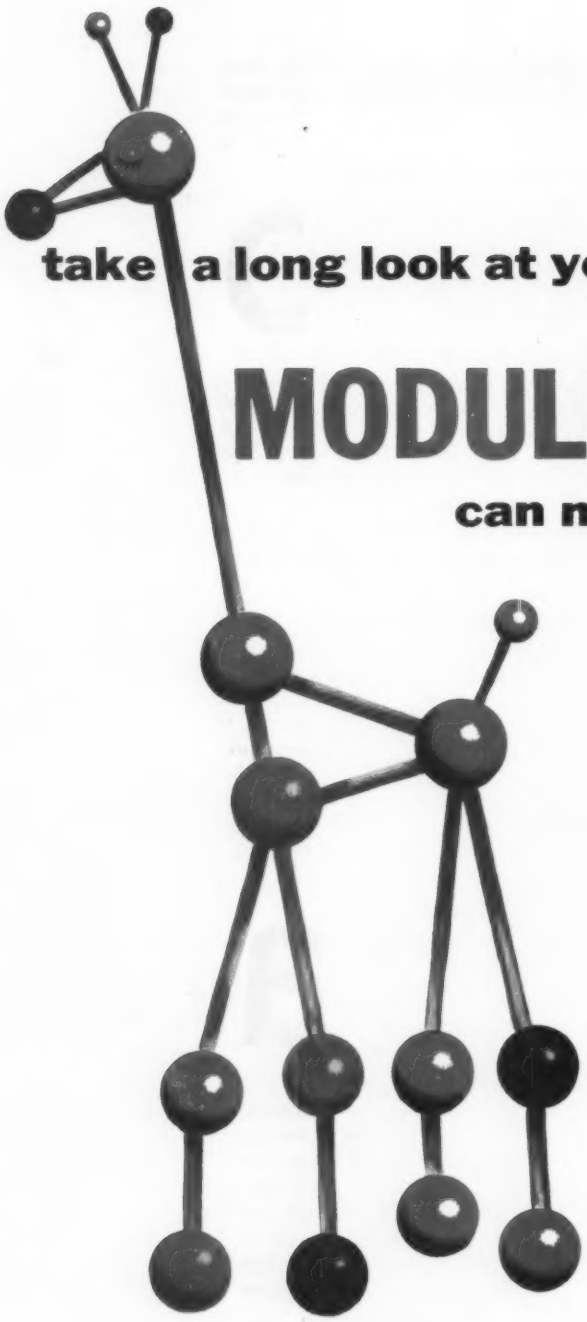
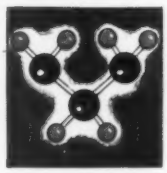
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

Chemigum, Pliolite, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



take a long look at your product...

MODULENE*



can make it better!

Modulene's high-quality consistency allows you to increase your production and improves the appearance of your product. Modulene comes in a number of formulations which will meet your most exacting requirements.

SUPER MODULENE

Super Modulene is a linear polyethylene that can be cooked and sterilized. Its outstanding physical qualities make it the perfect material for products that must stand heat and wear. Washing machine agitators, bottles, pipe, brush handles, houseware items and air conditioner parts are just a few of the hundreds of applications of Super Modulene.

Call on Muehlstein and find out how Modulene and Super Modulene can make your product better.

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now

Kurz-Kasch announces an important development; the ability to *mold* epoxy parts — in intricate shapes, with inserts — in large production quantities, with molding cycles and economy comparable to conventional thermosetting materials.

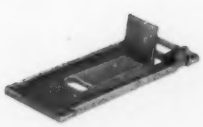
epoxy

The material is molded by techniques developed by Kurz-Kasch from resinous materials supplied by Booty Resineers Inc., Newark, Ohio.

molded

It is no longer necessary to limit yourself to casting procedures to get the benefits of epoxy. Molding cycles are relatively fast; production costs are therefore low. Tooling costs are comparable to other high-pressure plastics.

parts

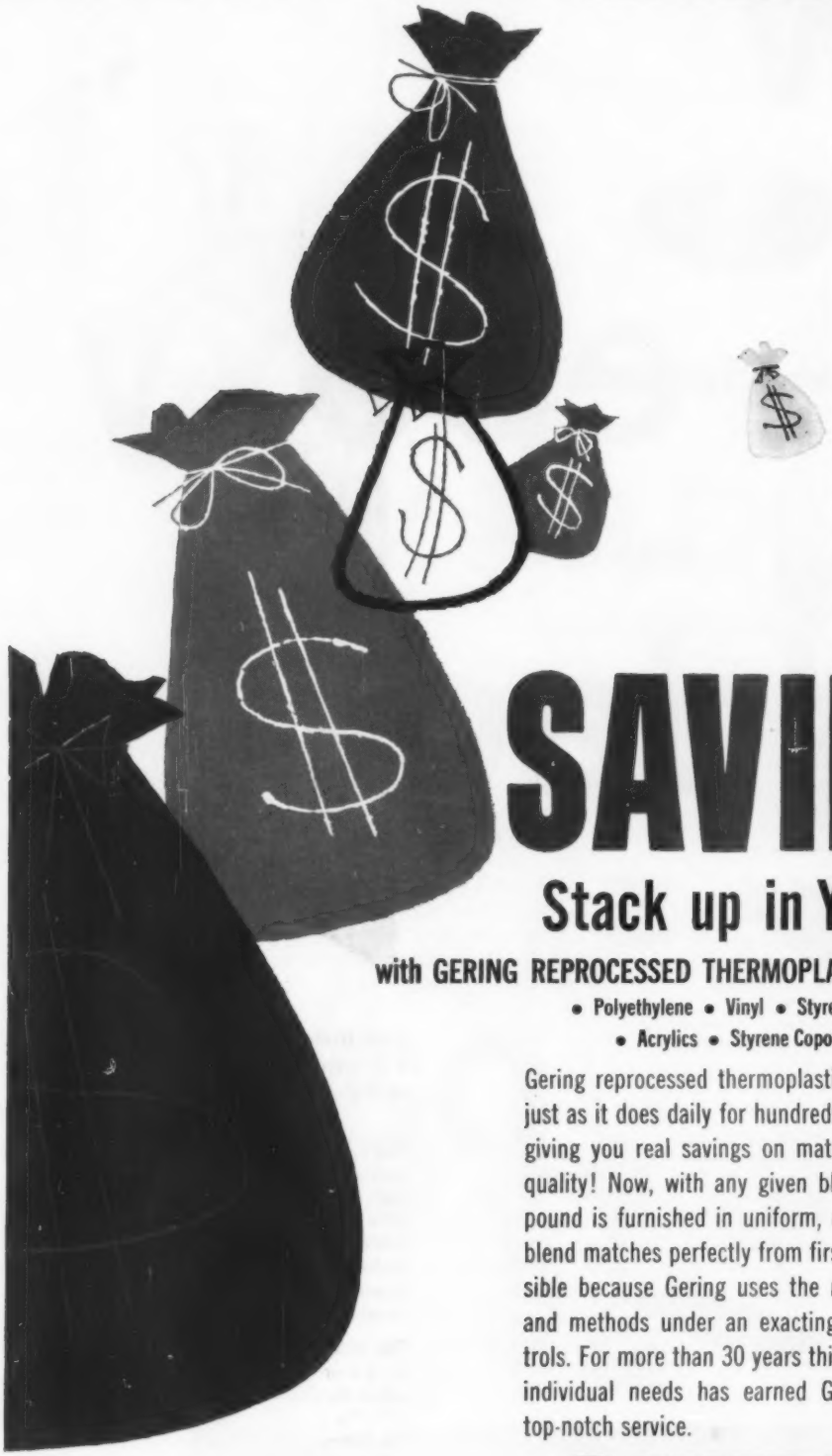


These parts have exceptional toughness, ability to hold inserts, resistance to moisture and most chemicals, and excellent insulating properties. Call your nearby Kurz-Kasch representative for quotes on parts molded of this material to your specs. Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio.

kurz-kasch

New York, Mt. Vernon, Mo 4-4866; Rochester, Hillside 0626; Beverly, Mass., Walker 2-0065; Chicago, Gladstone 6-8837; Detroit, Jordan 6-0743; Atlanta, Cedar 7-5516; Philadelphia, Hilltop 6-6472; Minneapolis, Walnut 6-2749; Dallas, Lakeside 6-5233; Pasadena, Ryan 1-6774; St. Louis, Parkview 5-9577; Toronto, Oliver 7986

GERING—FIRST CHOICE FOR QUALITY AND CUSTOM TAILORED MOLDING COMPOUNDS



SAVINGS

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with GERING REPROCESSED THERMOPLASTIC MOLDING COMPOUNDS

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Gering reprocessed thermoplastics can cut your costs—just as it does daily for hundreds of leading molders—by giving you real savings on materials without sacrificing quality! Now, with any given blend, your molding compound is furnished in uniform, dust-free pellets and the blend matches perfectly from first bag to last. That's possible because Gering uses the most modern equipment and methods under an exacting system of quality controls. For more than 30 years this response to customers' individual needs has earned Gering its reputation for top-notch service.

Special offerings of high quality reprocessed thermoplastics are announced through a new bulletin service. We'll be glad to send these money-saving notices to you. Just send us your name.

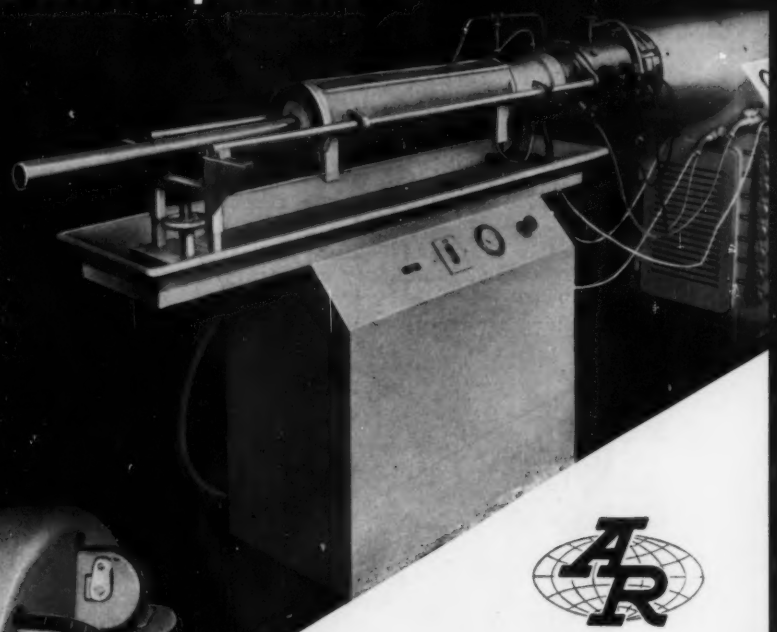
GERING
Molding Powders

Gering Products, Inc., North 7th St. & Monroe Ave., Kenilworth, N.J. • Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. • 424 Chevy Chase Rd., Mansfield, Ohio

TWO advances in processing thermoplastics

BOPP

1. Calibrating device
   patents applied
2. Pipe and cable haul off
   patents applied



Both of these new technical developments ease the manufacture of thermoplastic pipes by extrusion.

1. The calibrating device guarantees pipe true to size and shape when forming the extruded raw material. With this device the still soft section of the pipe is sucked to the inside wall of the calibrating device and cooled. In this way the thermoplastic material while passing through the calibrating chamber hardens into exact size and round shape required.

2. The pipe and cable haul off grips the pipe securely by six or three rubber covered catterpillar tracks set at an angle of 60° or 120° and pulls in keeping with the extrusion speed. The long working face of the catterpillars in firm contact with the pipe gives a high traction without slip and prevents deformation.

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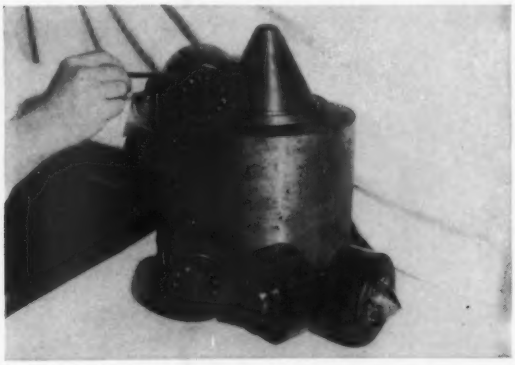
WHAT MAKES IMS SUPERHEATERS BETTER

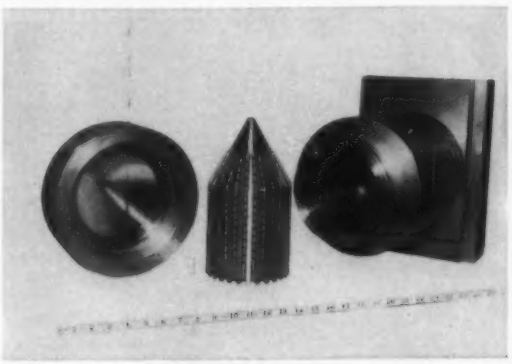
HERE IS SOME OF THE HANDWORK, CRAFTSMANSHIP AND "KNOW-HOW" THAT GO INTO THE MAKING OF IMS LEAKPROOF REPLACEMENT HEATING CYLINDERS . . . PRECISION TAILORED TO BOOST CAPACITY OF YOUR OLDER INJECTION MACHINES

Jobs sometimes start using a sample heater. Here we look over a worn out #10 Reed-Prentice, to be replaced by an IMS one piece leakproof oversize cylinder. Doubles press output.

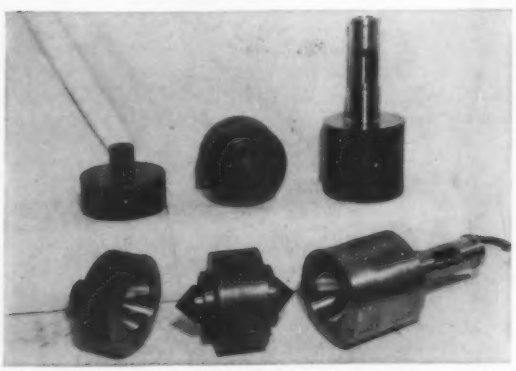


IMS integral (solid) heated spreaders pour heat into the plastic from both sides. Here small 5 inch spreaders for 2-3 oz. Van Dorn, Moslo and Fellows are contrasted with a 14 inch unit for a 60 oz. Watson-Stillman.

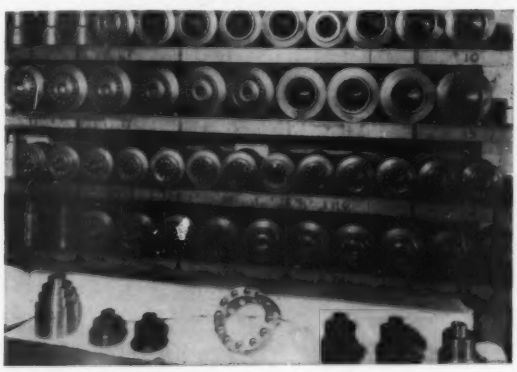
It takes lots of handwork to make a good heater. Here spreaders for new and repaired cylinders are being polished. Spreader at left has seen five years service.



Yes-we make experimental cylinders too. Here is a huge polyliner type unit made to order. Tests prove it has less than half the capacity of a standard IMS Replacement Cylinder for the same machine.



Stock cylinders for 2-1/2 oz. Van Dorn quadruple plasticizing capacity. We make high output heaters for Stokes, Reed, Fellows, Impco, in fact for every type of injection machine.



Our vast stock of spreaders permits fast service on IMS uniform design Replacement Heaters for all Reed, HPM, Watson, Impco, De Mattia, Lombard, Lewis and other types of presses. Over 850 IMS cylinders now in use.

Injection Molders Supply Company

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Let's CUT COSTS

on these Secondary Operations

- DRILLING
- REAMING
- TAPPING
- TURNING
- MARKING
- PUNCHING
- GRINDING
- ROUTING
- SAWING
- THREADING

High cost second operations can kill first operation profits. If you perform any of the above secondary operations, better take a critical look at how you do it. There may be cost saving opportunities you've overlooked.

If any one of them involves hand feeding of parts or tools—hand clamping—or mechanical means of performing push, pull or lift motions—The Bellows Co. can save you money.

The Bellows Air Motor and the numerous Bellows packaged pneumatic work units can, in a few minutes, transform hand operated machines and machine tools into fast automatic or semi-automatic production units. They are inexpensive to buy—your own tool room can install them quickly.

Here's how to start—

Write for these two booklets. Bulletin ML-3 and BM-25 will give you a quick picture of what others are doing—of what you can do—in cutting second operation costs. Write Dept. MP1157, The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

The Bellows Co.

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The Hannifin valves you buy today incorporate the very latest results of never-ending testing and development. Versatility of application and dependability of operation are winning them their position of leadership.

See your Hannifin man. Find out for yourself why Hannifin air control valves are so rapidly becoming first choice for automatic operation.

AIR CONTROL

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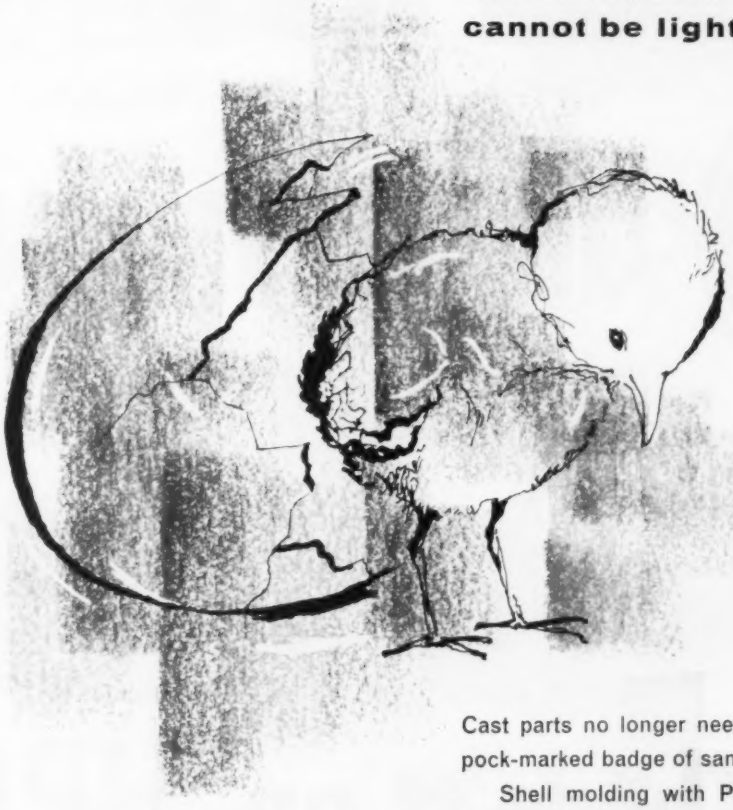
VALVES

For this complete catalog showing all the Hannifin directional air control valves, write to Hannifin Corporation, 553 South Wolf Road, Des Plaines, Illinois.

PLENCO SHELL MOLDING RESINS

the shell, dear friend, cannot be lightly dismissed



Cast parts no longer need emerge wearing the pock-marked badge of sand casting.

Shell molding with Plenco phenolic resins has made that rough-hewn appearance obsolete. Now, parts can be cast with smooth surfaces that require little or no polishing. And machining required is negligible, or often even completely unnecessary.

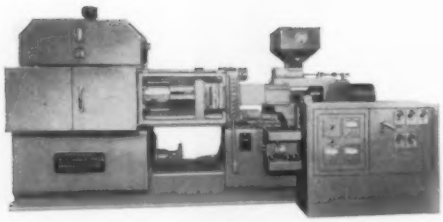
Plenco phenolic shell molding resins form light, dimensionally accurate molds. They are adaptable for most metals, even hard-to-cast ductile iron. And the molds are extremely durable.

The savings in time and money are easily apparent. Apply these economies to your production. Consult with Plenco about **your** product or product-problem.

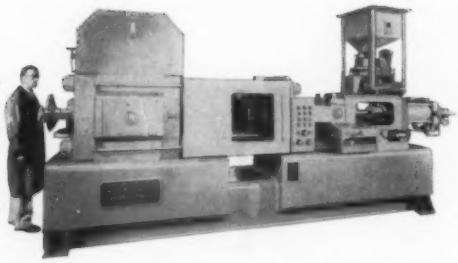
PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



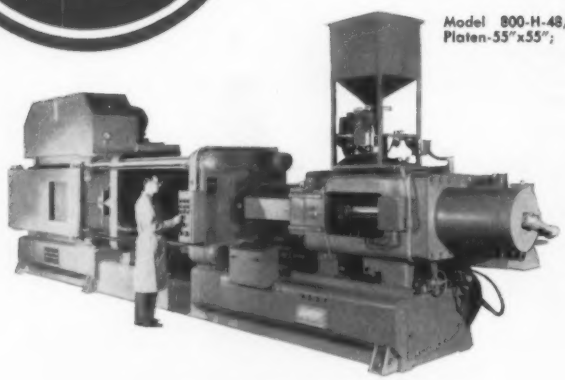
Model 200-H-6/8 Injection Machine
Platen-26"x26"; Stroke-15";H.P.-30



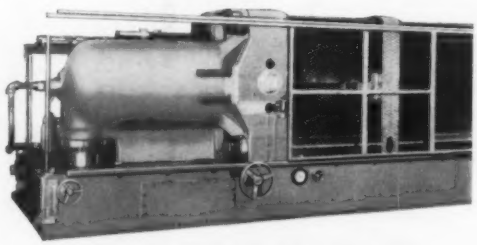
Model 300-H-12/16 Injection Machine
Platen-30"x33"; Stroke-20"; H.P.-45

HPM GREATEST LINE -

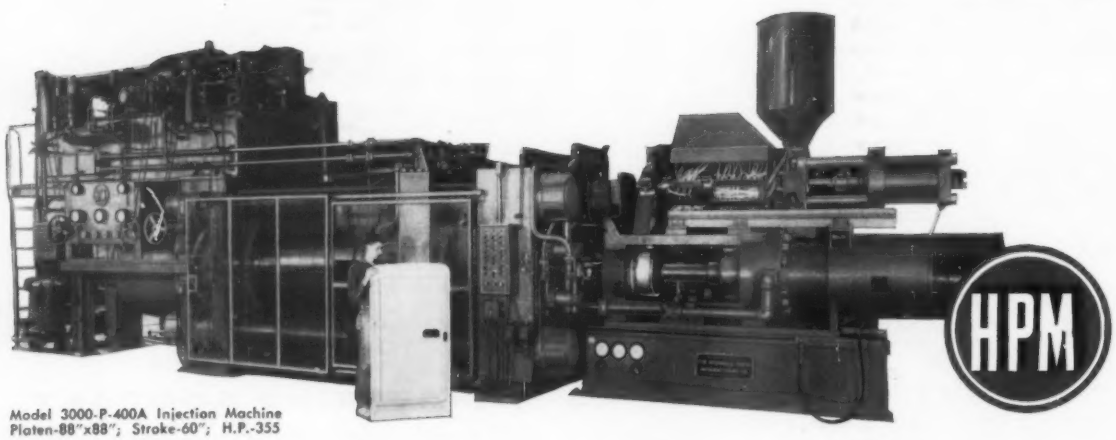
Model 800-H-48/64 Injection Machine
Platen-55"x55"; Stroke-35"; H.P.-127



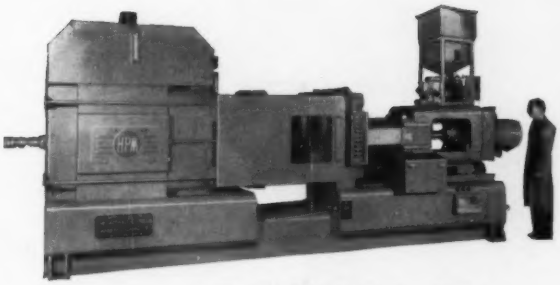
Model 1200-H-80/100 Injection Machine
Platen-60"x68"; Stroke-36"; H.P.-100



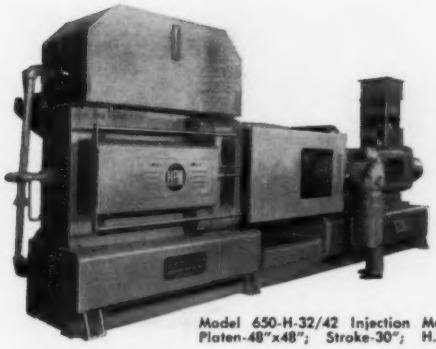
There's an HPM



Model 3000-P-400A Injection Machine
Platen-88"x88"; Stroke-60"; H.P.-355

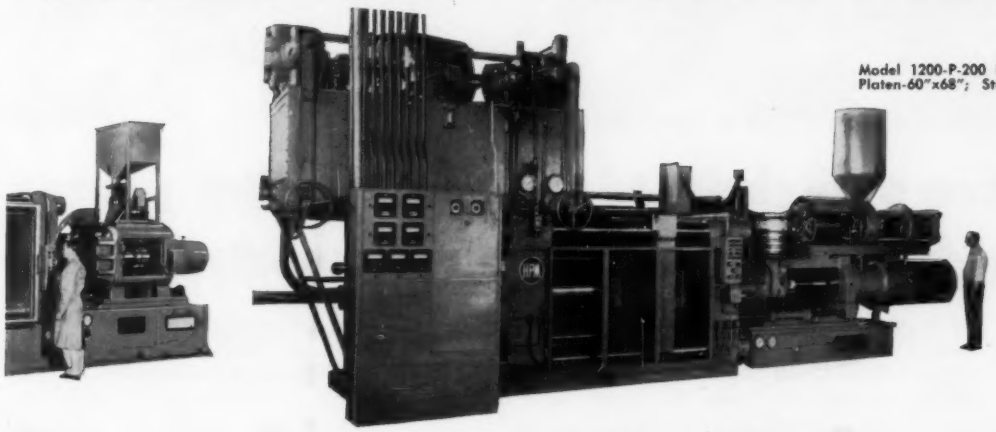


Model 450-HV-20/28 Injection Machine
Platen-36"x42"; Stroke-25"; H.P.-75



Model 650-H-32/42 Injection Machine
Platen-48"x48"; Stroke-30"; H.P.-107½

GREATEST ACCEPTANCE



Model 1200-P-200 Injection Machine
Platen-60"x68"; Stroke-36"; H.P.-355

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Other Sizes Built To Special Order

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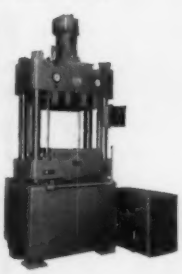
Stock Sizes-100-200-300-500-Tons
Other Sizes Built To Special Order

Compression Presses
Stock Sizes-100-200-300-
500-Tons Other Sizes Built
To Special Order



THE HYDRAULIC PRESS MFG. CO.

A DIVISION OF KOEHRING COMPANY, **MOUNT GILEAD, OHIO, U. S. A.**

"Abrasion resistance is nylon's chief advantage in this application," declares Bob Kile (office manager of the Line Scale Company in Oklahoma City), as he discusses with Ray Stroud (General Manager of Continental Plastics) reasons why nylon makes a better oil pipeline valve. Read below how nylon outperformed both metal and other resins.

Oil field equipment manufacturer reports:

"Why we switched to pipeline valve plates molded by Continental from Spencer Nylon"

Unique combination of durability plus "give" offers ideal solution to equipment problem:

"Special problems arise in the manufacture of oil pipeline valves," explains Bob Kile, office manager of the Line Scale Company, Oklahoma City, manufacturers of oil field equipment. "We don't use metal disks; with metal working against metal 500 times a minute a brass fitting would soon be pitted.

"A thermo-setting plastic disappointed us, too. The material was laminated, and fluids would penetrate the crevices until they soaked off a layer of the valve. And because of its relatively low abrasion resistance it, too, often became pitted.

"But Spencer Nylon solved the problem. Using Spencer Nylon, Continental Plastics molded for us a piece which has operated so satisfactorily that we are now using nylon valves in the chemical field as well as for petroleum!

"Nylon outlasts other plastic materials many times over in this application," Kile declares. "Before, when a piece of grit got under the plate, pressure of the liquid began to erode the plate. Nylon, however, has a tendency to 'give' in such a case, rather than to pit, and then the particle washes away.

"In our own test, we circulated brass shavings in water through a pump, and found that the shavings imbedded themselves in the nylon but didn't hurt the efficiency of the valve. Washing later carried the shavings out. In addition, with a nylon disk, when one side gets worn, you can turn it over and use the other side."

At the same time, Spencer Nylon has many advantages to molders. It is more dependable and easier to mold than old-type nylon. That's because Spencer Nylon has a wider plasticizing range and a wider temperature working range.

You, too, may find that Spencer Nylon offers an ideal solution to a molding problem, or that a Spencer Nylon-molded part gives you the exact combination of features that some phase of your manufacturing process demands. For more information, write to Spencer Nylon, Spencer Chemical Company, 523 Dwight Building, Kansas City 5, Missouri.

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SPENCER

SPENCER CHEMICAL COMPANY

GENERAL OFFICES: DWIGHT BUILDING, KANSAS CITY 5, MISSOURI

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ENGINEERED by a widely recognized specialist, with 23 years in the aircraft and 10 years in the plastics field—E. Chris Mireau, Vice President, formerly V. P. in Charge of Mfg. at Zenith. Experienced in aircraft manufacturing, quality control, tooling, process engineering and fabricating of assemblies, wing tips, radomes, etc. of reinforced plastics.

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Pictured above—Convair 880 Jet-Liner

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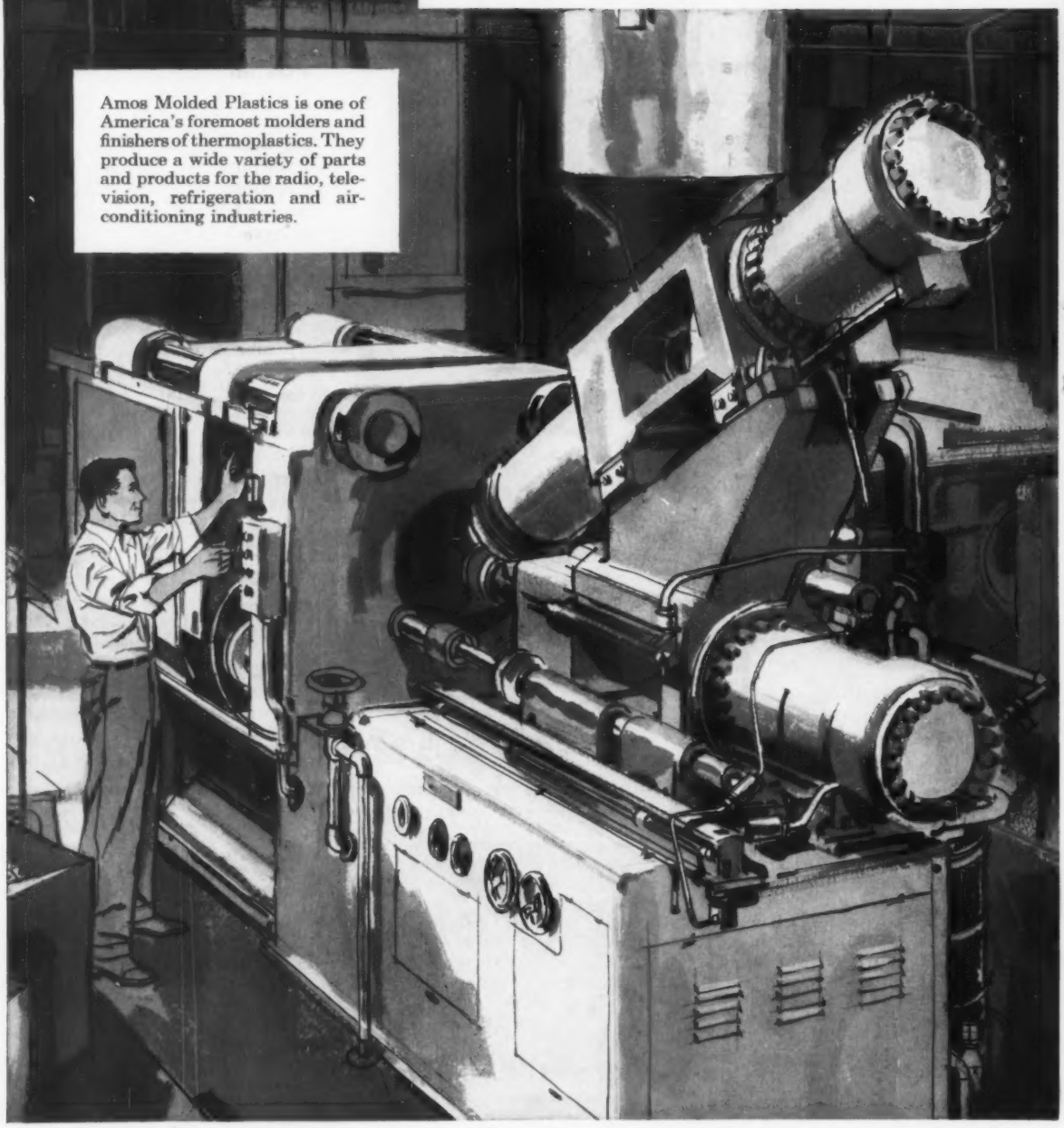
Correct Lubrication in Action...

Hydraulic Pump

Amos Molded Plastics is one of America's foremost molders and finishers of thermoplastics. They produce a wide variety of parts and products for the radio, television, refrigeration and air-conditioning industries.



Mobil **SOCONY MOBIL**

Leader in lubrication for over 91 years

in the **Plastics Industry**

Maintenance Cost Cut 44%

One of many maintenance savings achieved for Amos Molded Plastics with the help of Socony Mobil

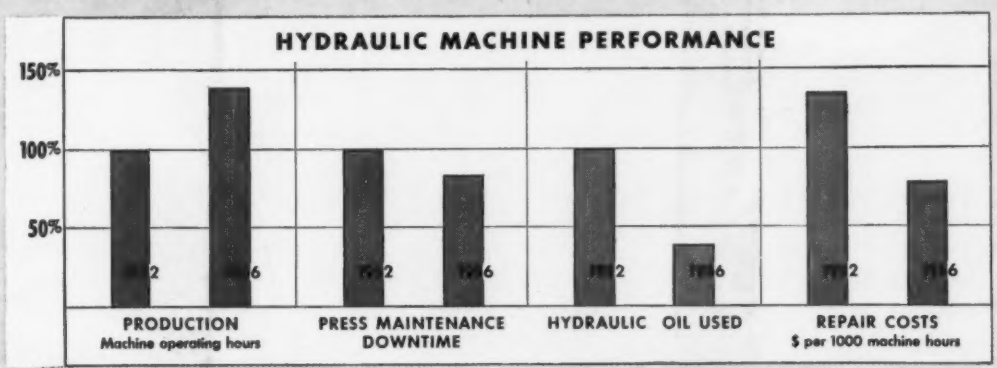
Despite a 37% increase in production hours over a five-year period, Amos Molded Plastics has managed to reduce maintenance and production costs consistently. This leading plastics manufacturer credits Socony Mobil's program of Correct Lubrication with a good share of these savings.

To illustrate: Records show that in 1952 molding machine hydraulic pump repair costs ran $135 per 1000 operating hours. Mobil engineers, working closely with the plant engineer, analyzed maintenance procedures . . . suggested improvements. They helped set up lubrication schedules for each machine . . . recommended the correct Mobil product for all equipment. Today, in spite of higher labor and parts costs, repair expenditures have been cut to $76 per 1000 operating hours . . . a reduction of 44%.

This is Correct Lubrication in Action—the only program that gives you the benefit of 91 years of lubrication knowledge . . . the services of more experienced lubrication engineers . . . top-quality products. It cut costs for Amos Plastics. Why not for you?

How Correct Lubrication Cuts Maintenance Costs

Graph shown here gives an accurate picture of results achieved for Amos Plastics through Mobil Correct Lubrication. Some ways this remarkable record was accomplished are detailed below.



Machine downtime cut—Excessive downtime of molding machines was found to be due to oil leakage and oil contamination. Mobil engineers recommended improved oil seals . . . set up periodic laboratory analyses . . . proposed annual cleaning of hydraulic systems. This cut downtime 17% . . . saved $13,800 over 1952 figures.

Oil consumption cut sharply—Socony Mobil maintenance clinics, conducted for plant's hydraulic engineers, taught them latest methods of reducing leakage. In addition, because Mobil hydraulic oils are of top quality they can be reprocessed and used indefinitely. Result—oil use was reduced 63% . . . $4,600 saved yearly.

These savings and many more helped Amos Molded Plastics increase profits. For information on how Mobil Correct Lubrication can cut costs, improve production, contact your Mobil representative.

Correct Lubrication

A proved program to reduce maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

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WOPALON
Cellulose Acetate in sheets, tubes and rods.

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Acetate powder for injection molding and extrusion.

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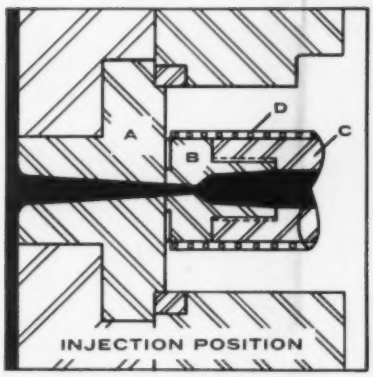
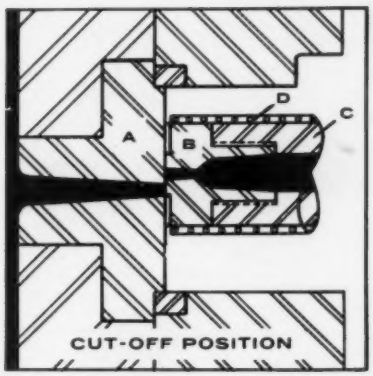
Three tough jobs show why you get better * nylon parts from Lesters

THE CLUE IS IN THE SPRUE



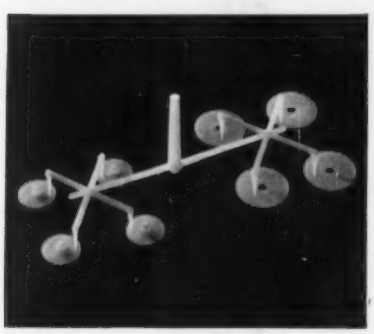


A—SPRUE BUSHING
B—FLAT NOZZLE
C—NOZZLE EXTENSION
D—NOZZLE HEATER

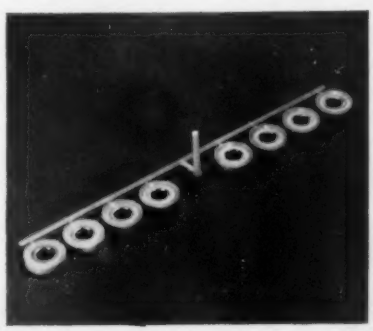
Look at the sprue on any of these nylon shots...it is clean and sharp, with no "string" or lamination or other evidence of frozen material. You *know* it was molded on Lester Injection Molding Machines. The sketch above shows why.

MECHANICAL SHUTOFF

On all Lester machines which mold nylon, the exclusive cut-off attachment allows free flow of the material in the injection position. However, before the mold opens, by the simple device of lifting the flat nozzle out of register with the sprue bushing, the material is effectively cut off, providing a clean, sharp sprue, and at the same time holding the molten material ready for the next shot in a heated zone until the instant of injection.



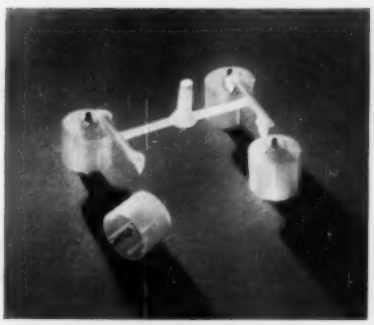
Conventional molding machines make use of a reverse taper in the sprue bushing, a baffle in the nozzle, or other such device to restrict the rate of drool. In the Lester *there just is no drool!* The quality of the material delivered to the cavity is not diminished by exposure to a cold sprue bushing or restrictions in the nozzle area.



Likewise, on conventional machines, a great premium is placed on the skill of the operator in removing parts from the machine at a precisely constant rate so that there is no drool into the parting line. He must also be skilled enough to pick "strings" that may have resulted from previous shots.

MOLD AND PART DESIGN

The nylon parts illustrated here, like many others, would spell "trouble" without the Lester cut-off attachment. Notice the variety in both mold and part design: 3-plate molds, pin-point gates, thin wall sections, metal inserts, heavy section—and they are all routine injection jobs on Lester machines.



BETTER PARTS

Thus the combination of the Lester cut-off attachment with the Lester internally heated cylinder and four-zone pyrometer control (for perfectly plasticized material) assures the molder that he will produce nylon parts that are :

* 1. more resilient
2. more dense
3. whiter

and involve: 1. less supervision
2. less-skilled operators
3. less waste

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Harshaw also offers a broad line of organic pigment colors, as well as a full line of Aurasperse organic and oxide dispersions. The dry colors are for general color uses, while Aurasperse dispersions find application in emulsion paint formulations.

A partial listing

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Hansa Yellows
Benzidene Yellows
Pigment Scarlet
Fire Red Toner
Maroon Toner
Permanent Orange
Madder Lakes
Permanent Green
Blue and Violet Toners
Permanent Purples

DISPERSED PIGMENTS
Aurasperse Colors

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Yellow Oxides
Green Gold
Chlorpara Red
Toluidine Red
Naphthol Reds
Alizarine Reds
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Ultramarine Blue
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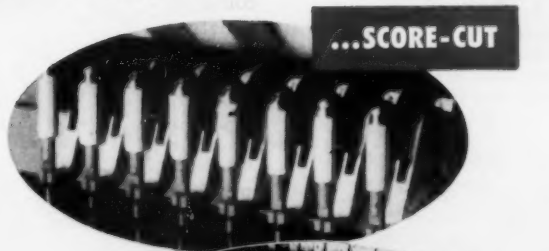

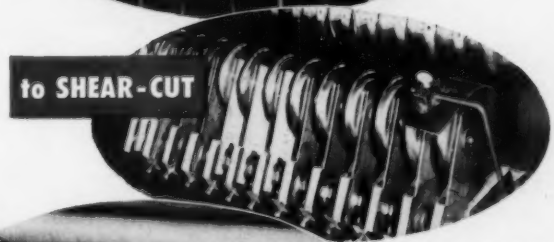

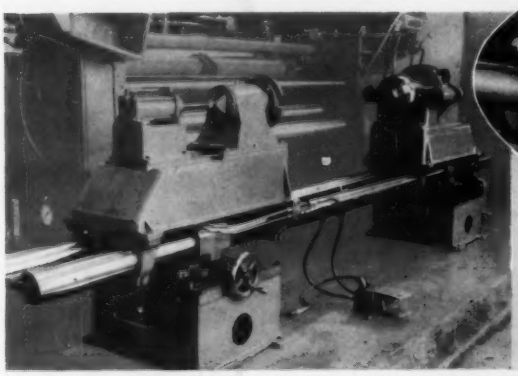

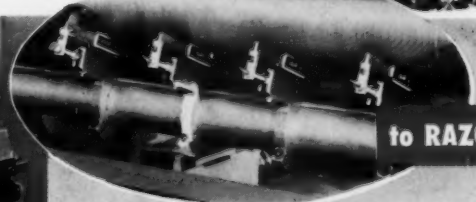

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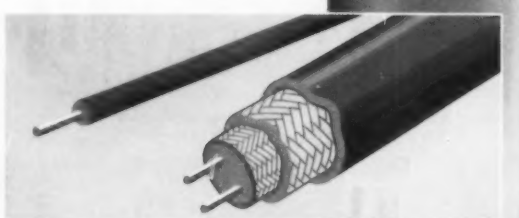
KP-200 primary plasticizer, a mixture of phthalate esters, is ideal for automotive wire coating compounds, plastic flooring and glove dipping formulations. Oil resistance is very good, residual odor is slight. Although not recommended for transparent films, opaque and translucent pastels can be produced at low cost.



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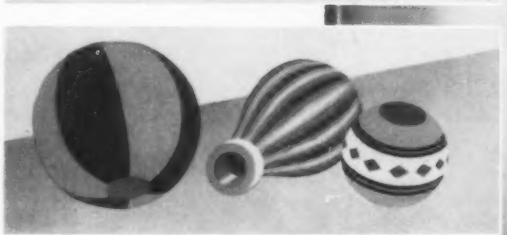
KP-260 primary plasticizer adds the bounce (85% higher than DOP) at a cost that is competitive. For the cost nothing equals KP-260 for resilience. Useful in plastisols, it has fair shelf life and good pseudoplastic flow properties. KP-260 is capable of holding high percentages of secondaries, such as chlorinated paraffin, without bleeding.



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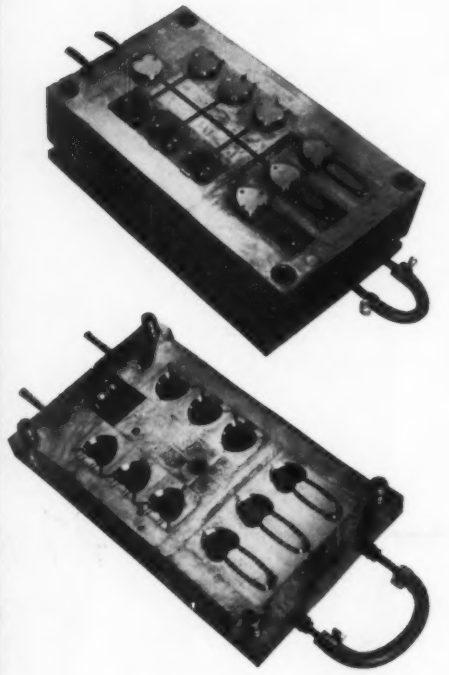

Parts for Plastic Rattles Made economically with Lustre-Die

One never knows where Lustre-Die tool steel is going to turn up next. At Shreve Molded Products, Youngstown, Ohio, it is used in an injection molding die to produce heart-shaped parts for baby rattles, made of acetate and styrene plastics. The mold was produced by Tri-Penn Tool Co., Erie, Pa., from steel supplied by Leed Steel Co., Buffalo, N. Y.

Engineers at Shreve like Lustre-Die for its wear-resistance and all-around economy, plus its ability to take a high polish. Working at 2000 lb injection pressure in a 12-oz molding machine, the die molds finished pieces at the rate of one per second.

Lustre-Die is an ideal steel for molding plastic parts because it takes an unbelievably bright, mirror-like polish. What's more, its basic analysis is just right for working with plastics. But we even go a step beyond that—we enhance Lustre-Die by means of alloy fortification, thus improving its already excellent properties. Then we oil-quench and temper this grade, so that it is ready for machining and polishing.

Lustre-Die is made in an electric furnace, and is carefully inspected to insure absolute cleanliness. It has a minimum of inclusion-causing additions. Besides, modern inspection methods hold injurious porosity to the minimum.

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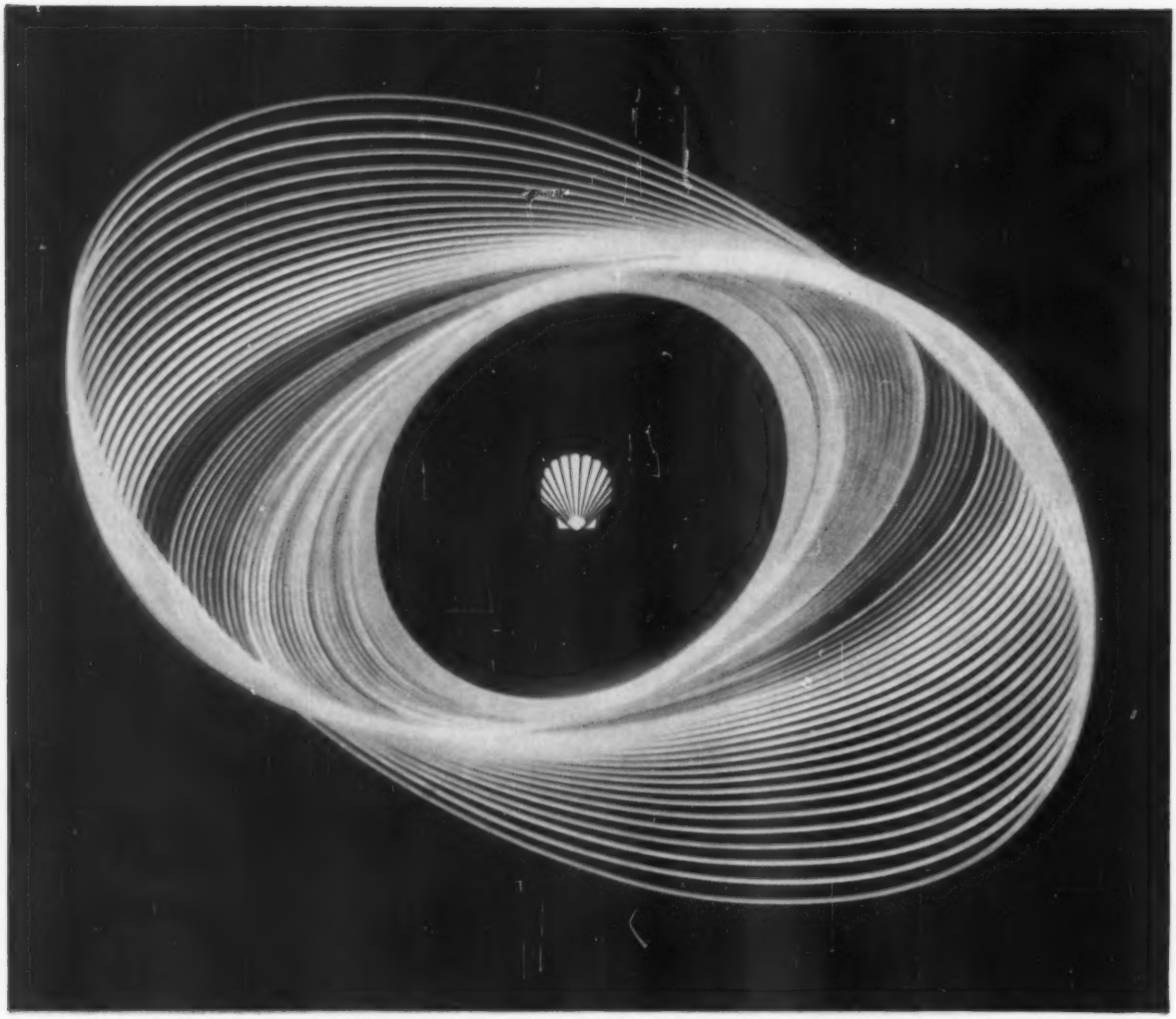

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SHELL

The Plastiscope* November 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Polyethylene takes over on news front. Like the Braves took the Yankees, so has polyethylene taken over the news headlines for the past six weeks. The chief news flashes have come from producers who are expanding their facilities—and this for a material that is sometimes called already overexpanded by those who are either faint of heart or can't see the forest for the trees.

The amazing fact now confronting the industry is that the latest announcements will bring total announced and estimated capacity for *high-pressure*-processed polyethylene up to, perhaps slightly over, 1 billion lb. some time in 1959. In addition, there may be capacity for almost 400 million lb. of low-pressure-processed polyethylene on hand at the same time, although one or two companies are still hesitant about expanding or building. The figures change frequently, but as of now the score is as above.

Sales capacity as of now. A little more than 300 million lb. of polyethylene was sold in the first half of 1957. Nearly all of it was high-pressure-processed material. Estimates for the year vary all the way from 610 to 650 million lb., perhaps 20 million lb. low-pressure-processed material in the last half. Estimates for present capacity of high-pressure material is under 700 million lb., but several plants are gradually adding new increments; on the other hand, there are several plants not operating anywhere near capacity.

It is interesting to note that polyethylene sales increased 140 million lb. in 1955; 160 million in 1956; and may increase by 130 or 140 in 1957. If the increase in the next three years is only 100 million a year, the industry will just about reach that magic 1 billion lb. figure in 1960.

Bakelite adds new high-pressure capacity. Perhaps the biggest bomb shell that broke during this period was Union Carbide's announcement that facilities for producing Bakelite *high-pressure*-processed polyethylene would be increased by 72 million lb. in a new plant at Whiting, Ind., to be completed in the first half of 1959.

Thus did Bakelite confirm its belief in the future for high-pressure (low-density) polyethylene and back up a statement of Union Carbide's executive vice president, Howard Bunn, who told a gathering of security analysts several years ago that Bakelite was then the largest volume producer of polyethylene and intended to stay that way. The company's total high-pressure-process announced capacity before this addition was around 250 million lb., but most observers thought 300 million was a more realistic figure. And in addition, of course, there are the 55 million-lb.-capacity plants for production

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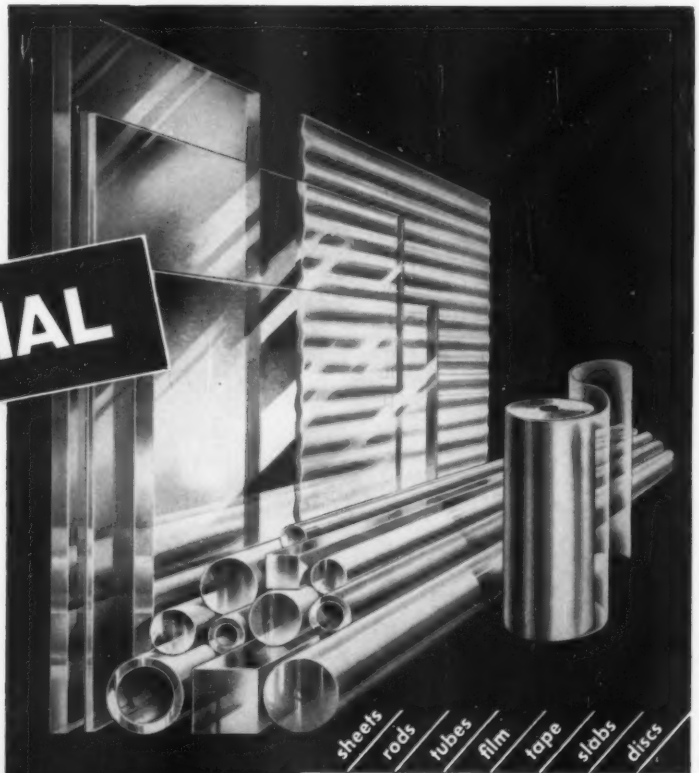

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TEFLON	√	√	√	√	√	√	
VINYLITE	√	√	√				
ACETATE	√	√	√	√			
POLYSTYRENE	√	√	√			√	√
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The Plastiscope

(*Continued from page* 39)

of low-pressure-processed polyethylene which will soon be on stream. Too much emphasis cannot be given to Union Carbide's expansion in high-pressure-processed polyethylene. Obviously, they expect to keep their hand in low-pressure-processed material, but this last move seems to indicate an expectation that *high-pressure* will dominate the field for some years to come.

Another interesting sidelight is location of the plant near Chicago on practically an over-the-fence site next to a source for ethylene in Whiting and right in the heart of a big consuming area for polyethylene.

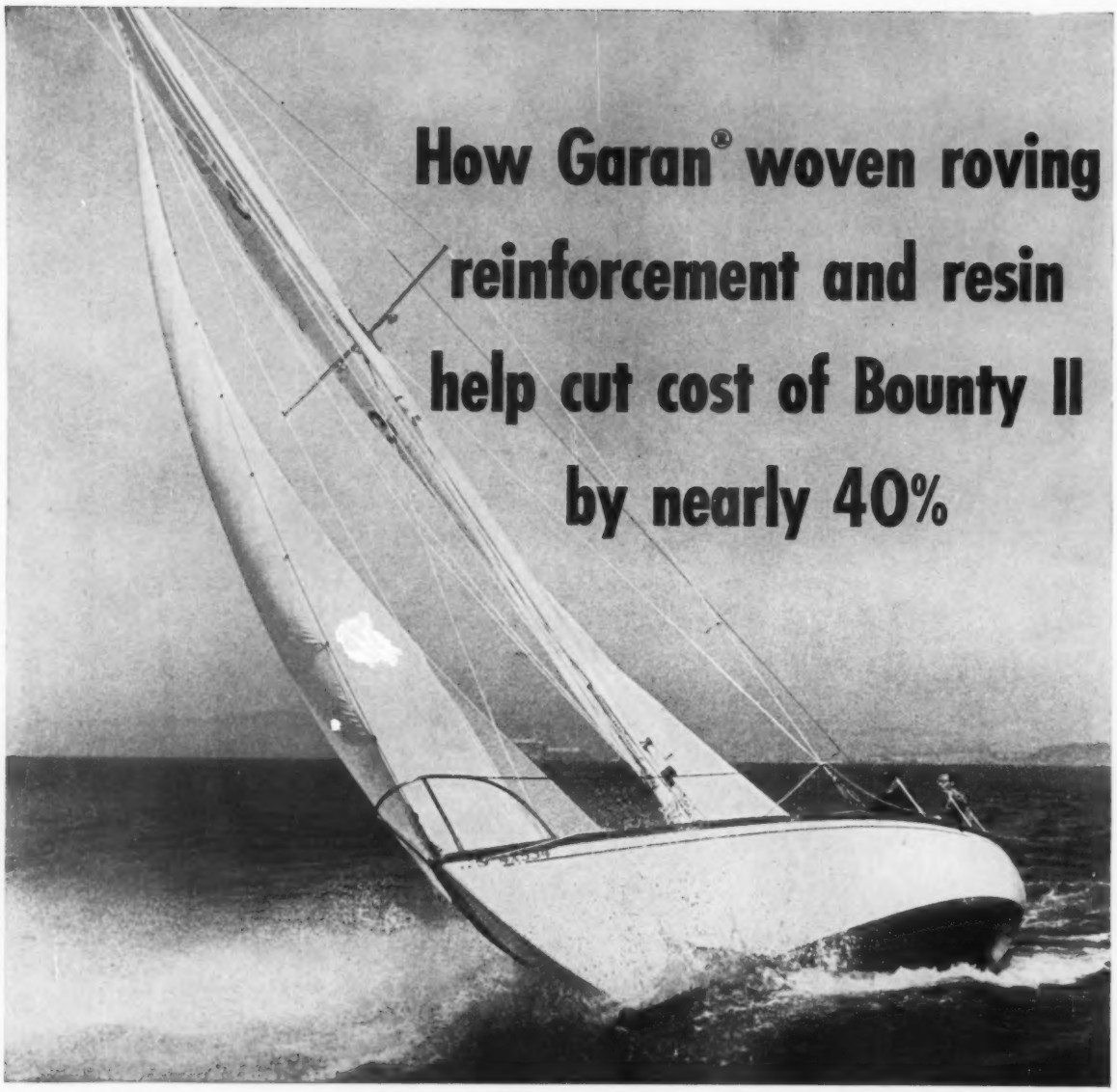
Du Pont gives notice of position on linear polyethylene. When last month's announcement was made that Du Pont's Canadian affiliate was about to enter the low-pressure-processed polyethylene field, it was a foregone conclusion that Du Pont of the United States was about ready. Hence the announcement from Wilmington that a linear polyethylene plant would be built in Laplace, La., was not as surprising as the Bakelite bomb shell. It has been known for a long time that Du Pont was researching the project and that an announcement would be forthcoming. Experimental quantities of the new resin have been produced in a pilot plant at Orange, Texas, during the past two years. Du Pont prefers to call its low-pressure-processed material "linear polyethylene" as compared with several other producers who call it "high density."

Perhaps the most significant part of the Du Pont press release was the last paragraph which read, "Two years ago the company announced that it had acquired a license to use a catalyst developed by Dr. Karl Ziegler, of Mulheim-Ruhr, Germany, for the manufacture of linear polyethylene. While this agreement makes it possible for Du Pont to use this catalyst, Mr. Hershey (general manager of the Polychemicals Div.) said he would not announce as yet whether it would be employed in Du Pont's contemplated commercial plant."

At the Notre Dame conference a year ago, there was much speculation concerning the Du Pont position on this matter with relation to patents. It is believed that the company applied long ago for patents pertaining to a polyethylene with extremely high density, and the industry is extraordinarily curious to know the relationship of the Du Pont patents to other polyethylene or perhaps even polypropylene patents. The last section of the above statement from Du Pont may be a significant reminder that Du Pont expects to keep the industry curious for a spell longer.

Weather-resistant polyethylene. Technicians from Tennessee Eastman told A.C.S. members at a recent meeting that its company would soon offer a weather-resistant polyethylene for use outdoors. It has been made possible as a result of recent developments in the field of ultra-violet inhibitors. In comparison with conventional polyethylene, the new compound shows no surface deterioration after being exposed four times as long to accelerated weathering tests.

U.S.I. plant at Houston. Last month U.S.I. announced a 75 million-lb. expansion for production of intermediate-density high-pressure-processed polyethylene. The



How Garan® woven roving reinforcement and resin help cut cost of Bounty II by nearly 40%

Molded hull, deck and mast of 40′-10″ Bounty II are made with Garan woven roving. Builder: Coleman Boat & Plastics Co., Sausalito, Calif.

Garan woven roving reinforcement helps make it possible to mold a 40-ft. Bounty II per week—at nearly 40% less than the cost of comparable wooden boats. Here's why:

Garan woven roving cuts production time and labor costs because it wets out 3 to 5 times faster. It conforms well to the mold . . . saves extra cutting and fitting. Because its greater bulk makes build-up 2 to 3 times faster, it costs less to use. And finished moldings are color-true because Garan woven roving adds no color of its own to pigmented resins.

Garan woven roving is a coarse, fabric-like reinforcement made from bundles of parallel glass fibers. The exclusive Garan sizing protects fibers during weaving, and improves glass-to-resin bond. This gives Garan woven roving special strength . . . makes possible stronger, more durable laminates.

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The Plastiscope

(*Continued from page* 41)

site has now been chosen on the Houston Ship Channel where ethylene can be obtained from the nearby Phillips Chemical Co. plant. The original U.S.I. plant at Tuscola is now said to be operating at a 100 million-lb.-per-year rate. Proximity of raw material and shipment by all means of transportation were chief factors in choosing the new location. Note: Far more than half of all the 1 billion lb. capacity ticketed for 1960 will be in the Texas-Louisiana area.

Dow enters the lists. Dow is building a multi-million-dollar plant at Bay City for production of linear polyethylene using a Ziegler license. It is scheduled for completion in October 1958. Dow has been operating a high-pressure-process plant for a couple of years and has operated a pilot plant for low-pressure polyethylene for two years. The company has been extremely quiet about its polyethylene operations, but those who have had an opportunity to see Dow's new linear material seem most favorably disposed, especially toward a film grade that has aroused considerable attention. C. B. Branch, manager of the Plastics Dept., stated significantly, "the company plans to make a major effort in this field." This might be interpreted to mean that Dow leans toward the high-density or linear polyethylene road.

Polyethylene for pipe. Use of virgin resin for polyethylene pipe is expected to top 75 million lb. by 1960, according to a survey report made by James E. Sayre, of the Barrett Div. of Allied Chemical, and reported at the recent A.C.S. meeting. He further stated that 55 million lb., including scrap, would be used for pipe in 1957. Some of his further statements were: Resin price has declined 16¢/lb. or 31% in five years. Farm water lines will be the biggest user in 1957 at 8 to 10 million pounds. Jet wells are next with 7 to 9 million pounds. Lawn sprinkler systems will use 5 million pounds. One farm in Indiana now uses over 1 million feet. A mink grower installed 2500 ft. of pipe to carry water to his pens. If only 1% of existing 1- and 2-family householders install a lawn sprinkler system each year, they would use 12 million lb. of polyethylene. If polyethylene were used for household piping only in suitable applications, it is possible that the consumption would amount to 100 million lb. a year. Golf course watering lines offer a 20 million-lb. market.

Paraflint for polyethylene. More than 1,200,000 lb. of Paraflint, a synthetic paraffin imported from South Africa, have been shipped to customers throughout the U. S. this year, according to Moore & Munger, of New York, who are the marketers. Most of it has been consumed by the plastics industry as a blend with polyethylene in small percentages where it is said to improve moldability, especially for large pieces. The price is around 15¢ a pound. Paraflint is available in surplus from S. Africa since it is a co-product of the petroleum companies which are producing gasoline and other petroleum-like products from coal on a rather large scale by the Fischer Tropshe process.

More urea and melamine. American Cyanamid is expanding its Wallingford, Conn. facilities for production of melamine and urea compounds by about

vinyl sentinel

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The Plastiscope

(*Continued from page* 43)

50 percent. The new quota will be available next year. Barrett Div. of Allied announced an expansion of similar size last summer (MODERN PLASTICS *34*, 43, July 1957). Both companies are vague about use of the word "compound" so there is no telling how much of this expansion is for molding material, but both emphasize one cause of need is the expanding growth of melamine dinnerware. There is no available evidence to indicate a growth in urea molding material.

The total amount of urea and melamine molding material sold in 1956 was around 90 million pounds. In 1953 the total was a little over 60 million. First half year sales for 1957 were around 45 million. A conservative estimate places melamine molding material sales alone at over 35 million in 1956—42 million or more in 1957. Before dishware came along, melamine molding material sales were under 10 million. Thus it is obvious where a great portion of the combined urea-melamine molding material total is coming from.

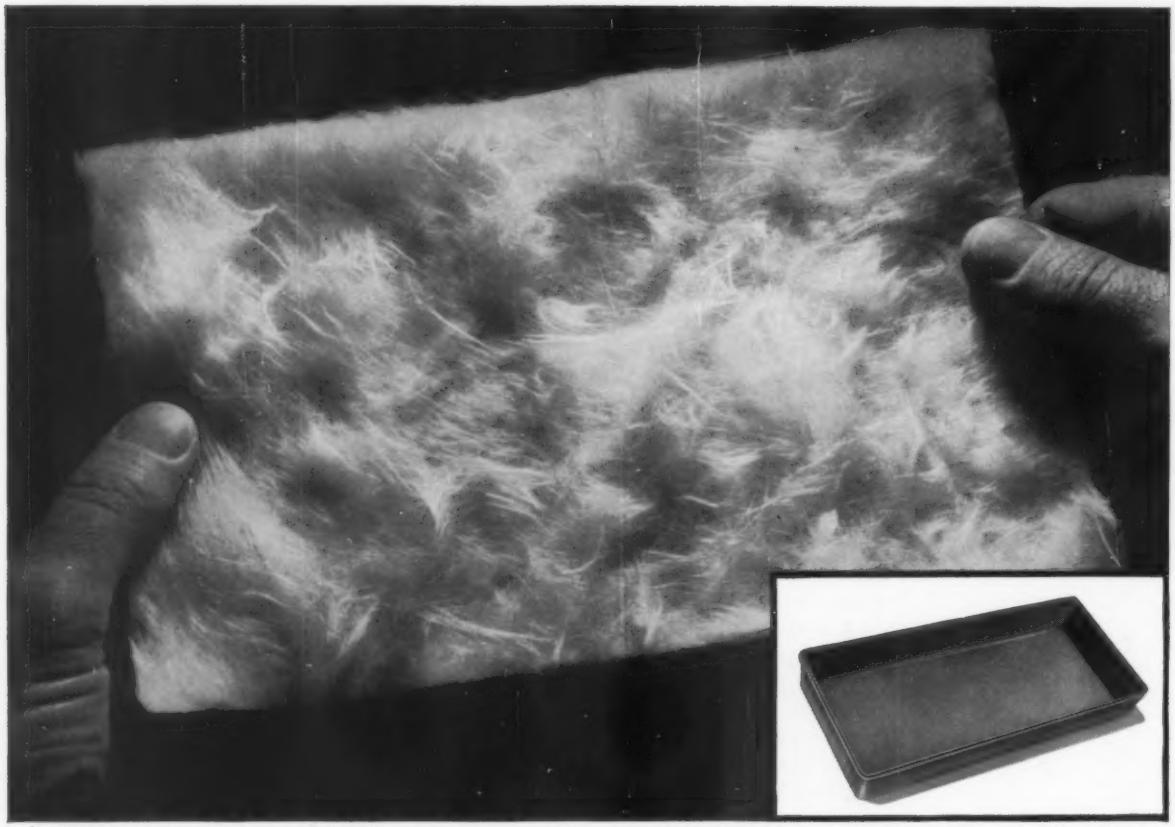
But there are many other volume uses for urea and to a lesser extent for melamine. Bonding and adhesive uses including urea glue for plywood and melamine resin for laminates have grown from 94 million in 1953 to 123 million pounds of resin in 1956. Total of all urea and melamine has grown from around 240 million in 1953 to over 300 million in 1956.

Thus when both major producers announce a 50% expansion in facilities for production of "compound" it could mean that they expect demand to grow faster in the near future than it has in the near past.

Fluorocarbon film. The Du Pont Film Dept. is planning to offer film made from Teflon 100-X perfluorocarbon in the near future. Semi-works facilities are now under construction although the new perfluorocarbon resin production will not start until 1959. The new Teflon 100-X is a type that can be extruded and perhaps some day can even be injection molded.

Film made from Teflon 100-X will be higher priced than Mylar but can be used in higher temperature ranges—is capable of continuous service at 400° F. and has excellent electrical insulating properties. Printed circuits are a promising use for this new film. It is heat-sealable and is unaffected by most chemicals and is suggested for tank linings, specialized containers, and certain outdoor applications.

Methacrylate in reinforced plastics. Progress of methacrylate as a resin for use with fibrous glass in the reinforced plastics industry has been very pronounced over the past year even though little has been said about it. The resin is a partially polymerized monomer in syrup form—virtually a prepolymer. Its cost is about the same as polyester resin. It cures more slowly than polyester, but the slow curing improves its properties. Its resistance to heat is better than most thermoplastics and generally considered adequate to meet service conditions where reinforced plastics are applicable. Its weathering properties are exceptionally good and it does not suffer from rain erosion as much as many other materials. There are still many differences of opinion concerning its eventual practicality, but Du Pont is plugging steadily away at improving a method by



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(*Continued from page* 45)

which it can be used and before many months have passed will doubtless wage a campaign to promote methacrylate as a resin for reinforced plastics.

Big volume uses for vinyl chloride. Large new industrial plants recently constructed or now under way are using vinyl chloride vapor barrier film to replace the vapor seal which was formerly asphalt. The latter is still used on top of the roof, but the vapor barrier between the roof surface and supporting members is now vinyl in many cases. One reason is that vinyl does not support combustion. Some builders say that the General Motors fire at Livonia might have been slowed down if a vinyl vapor barrier had been used. Large companies which have recently used Koroseal vapor barrier for new buildings are Chrysler at Twinsburg, Ohio, Ford, B. F. Goodrich, and the new Muskingum River power plant in Ohio.

Vinyl chloride for hotel service. Miami hotels are now using hundreds of feet of unplasticized Geon pipe for wire conduit, air conditioning, salt water lines for their pools, and wherever cold water is piped, except for drinking purposes. The new pipe is replacing short-lived, corroded metal pipe.

Still another big volume use and growing rapidly are extruded vinyl waterstops on seaways, construction jobs, and highways where it stops seepage between concrete slabs. The vinyl ribs of the extruded strip project laterally into both adjoining concrete slabs, thus bridging the joint that might otherwise allow the passage of water.

Those medium-price-range plastics. Two months ago a paragraph in this section was devoted to plastics that sell from 40 to 70¢ a pound and the particularly vigorous competition that is going on to capture segments of the markets available. Several significant happenings have occurred since that writing. For example, Hercules has abandoned production of all its cellulosic molding materials, including acetate, Hercocel-W, and ethyl cellulose. The company will continue to supply flake for producers who wish to produce molding powder therefrom. Hercules intends to concentrate all effort on its new Hi-fax high-density polyethylene and other olefin derivatives. Another producer, Goodyear, has discontinued production of Plio-Tuf molding material, a styrene-butadiene compound which sold for 41¢ a pound.

A different angle on the same subject is Eastman Chemical's announcement of a price increase for Tenite acetate which was raised 2¢ a pound. Their price for Group III (opaque) for molding is now 43¢ a pound in quantities of from 5000 to 19,999 lb; Group II for molding (translucent) is now 50¢; Group I (clear and colored transparents) is now 54 cents. In quantities over 20,000 lb. the price for Group III is 40¢; Group II is 48¢ and Group I is 52 cents. There was a previous price raise in September—a year ago the base price was 37 cents. Tenite butyrate remains at the same base price of 62¢ for over 20,000 lb. and 64¢ for 5000 to 19,999 pounds.

For additional and more detailed news see Section 2, starting on p. 278.

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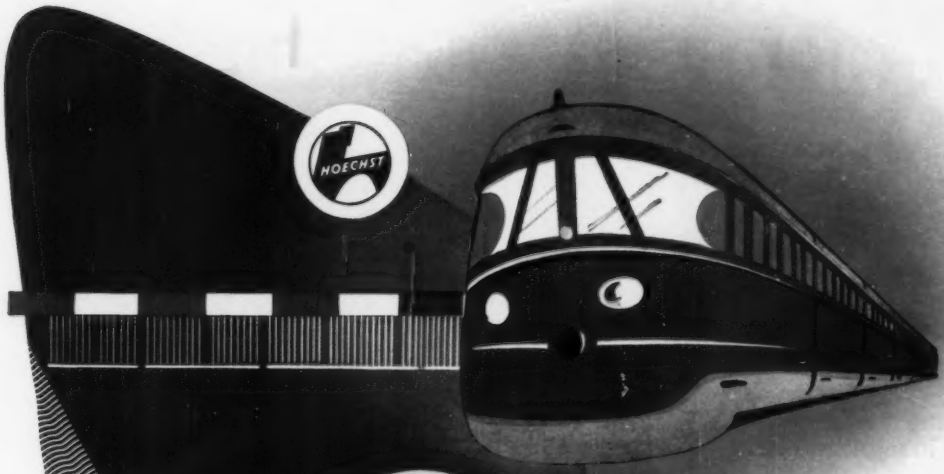

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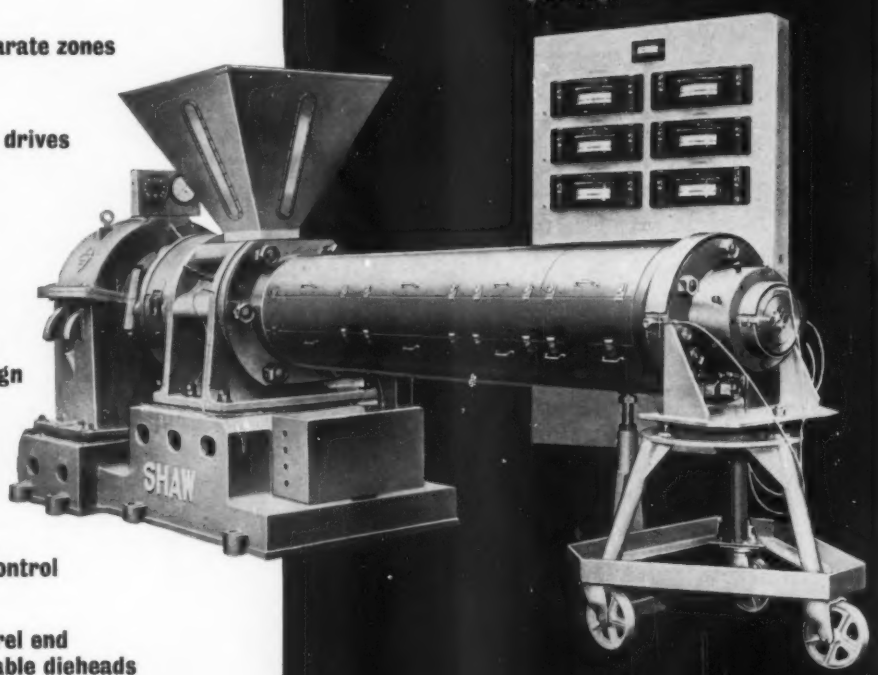

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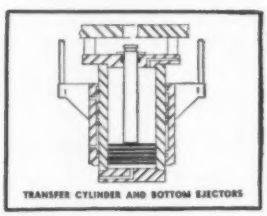

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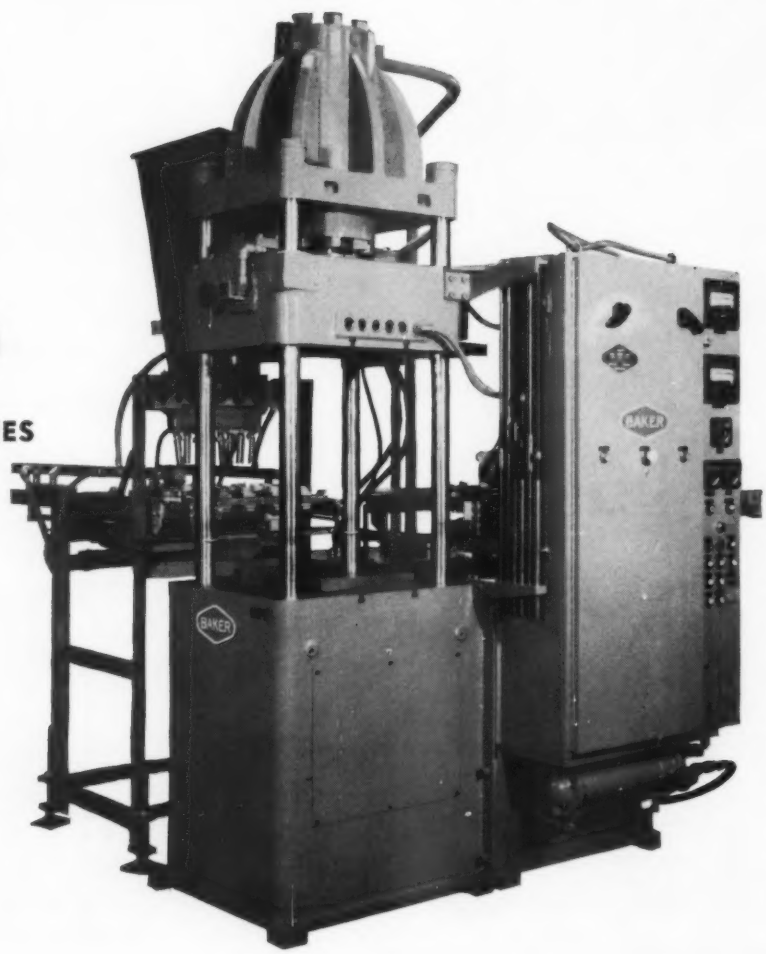
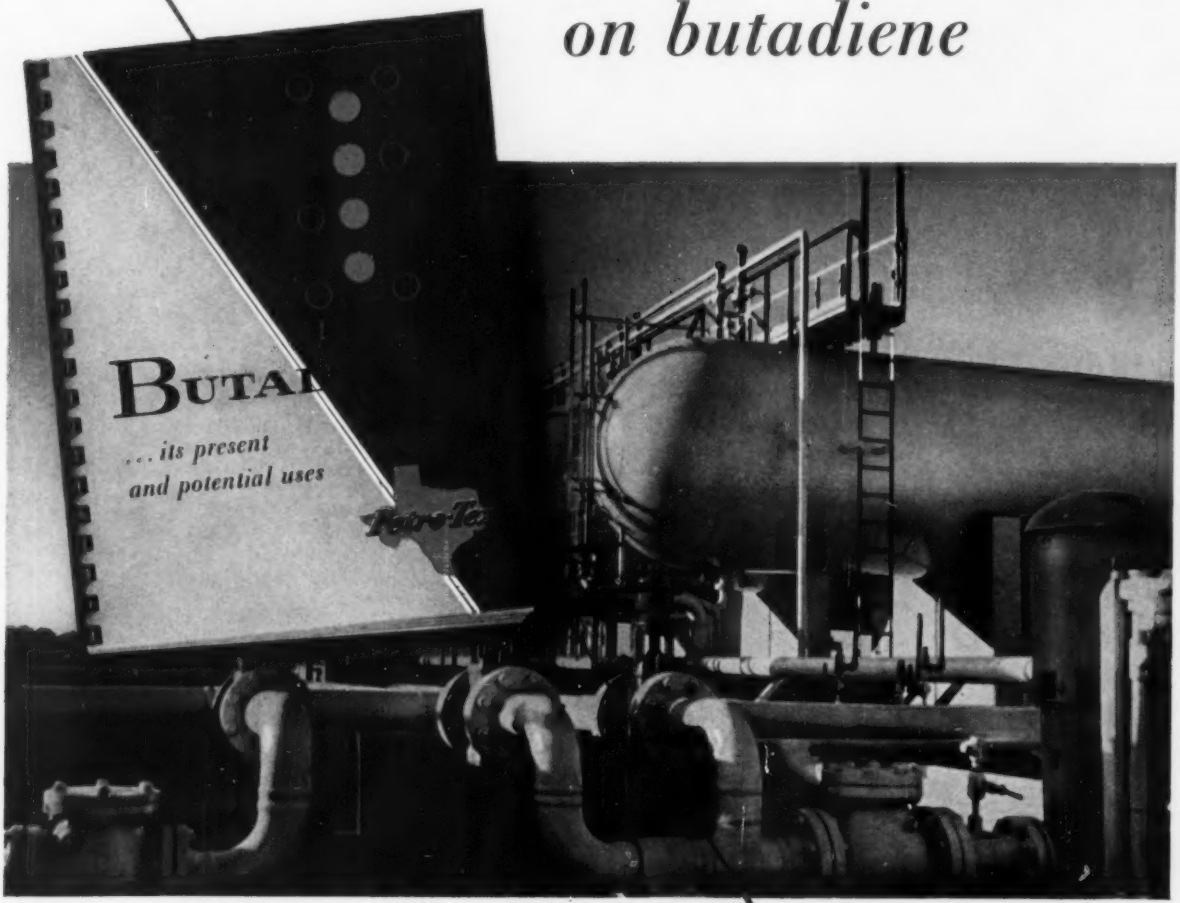


Just off the press *first technical manual on butadiene*



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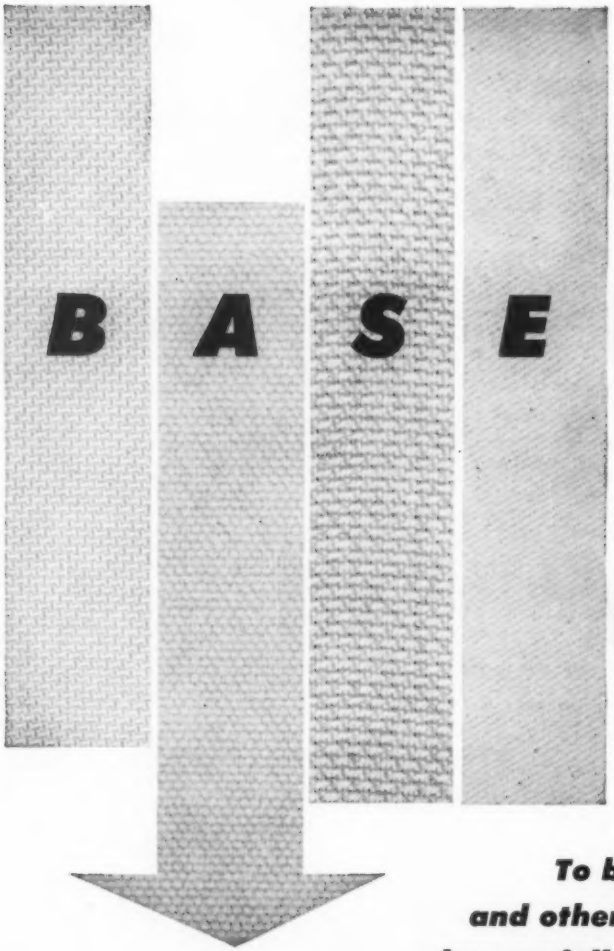

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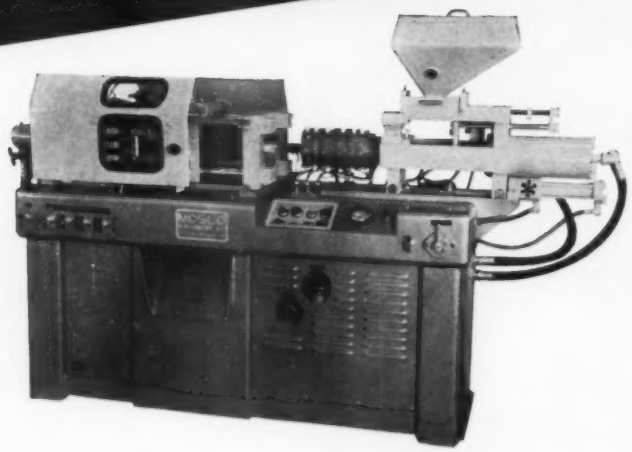

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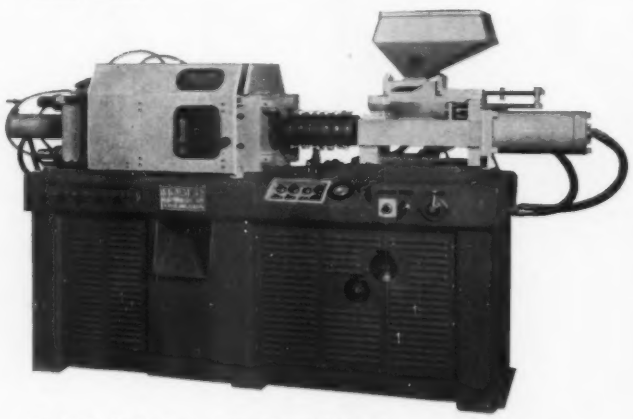

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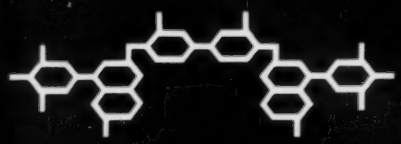

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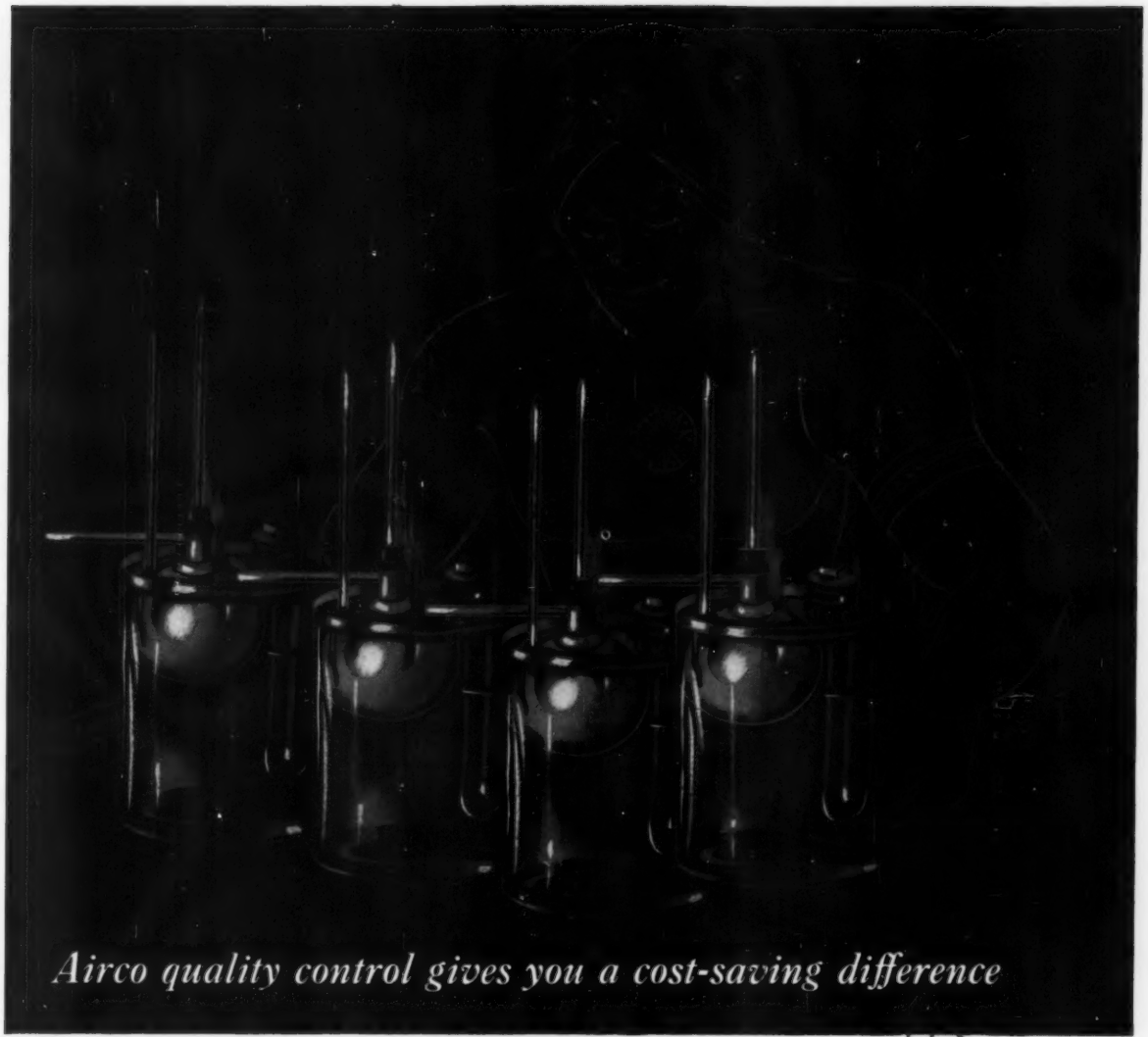

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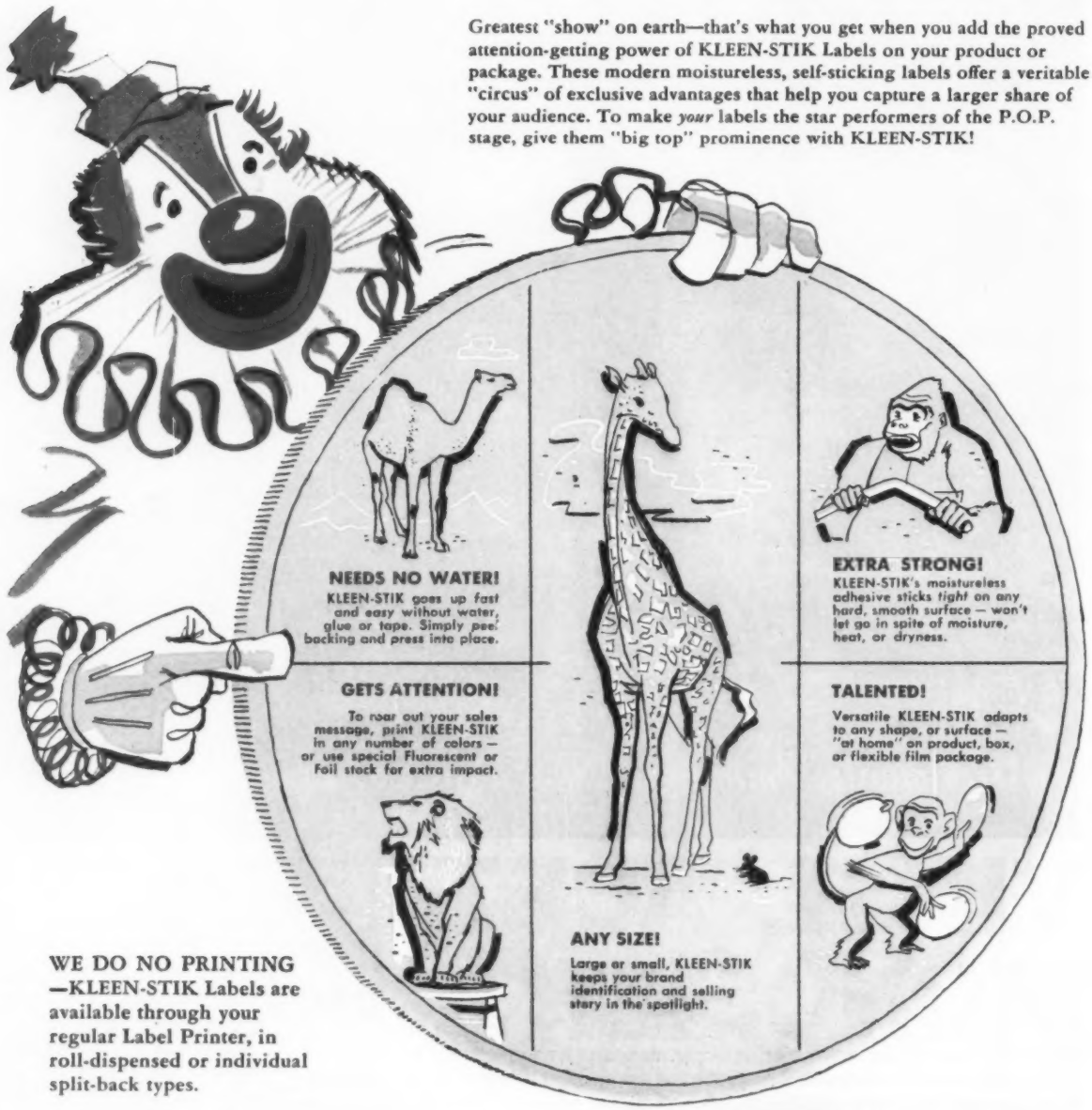
Greatest "show" on earth—that's what you get when you add the proved attention-getting power of KLEEN-STIK Labels on your product or package. These modern moistureless, self-sticking labels offer a veritable "circus" of exclusive advantages that help you capture a larger share of your audience. To make *your* labels the star performers of the P.O.P. stage, give them "big top" prominence with KLEEN-STIK!



NEEDS NO WATER!
KLEEN-STIK goes up *fast* and easy without water, glue or tape. Simply peel backing and press into place.

EXTRA STRONG!
KLEEN-STIK's moistureless adhesive sticks *tight* on any hard, smooth surface — won't let go in spite of moisture, heat, or dryness.

GETS ATTENTION!
To roar out your sales message, print KLEEN-STIK in any number of colors — or use special Fluorescent or Foil stock for extra impact.

TALENTED!
Versatile KLEEN-STIK adapts to any shape, or surface — "at home" on product, box, or flexible film package.

ANY SIZE!
Large or small, KLEEN-STIK keeps your brand identification and selling story in the spotlight.

WE DO NO PRINTING —KLEEN-STIK Labels are available through your regular Label Printer, in roll-dispensed or individual split-back types.

PRODUCT AND PACKAGE LABELS | NAMEPLATE LABELS | INSTRUCTION LABELS | CAUTION LABELS | PRICE MARKER LABELS

KLEEN-STIK Products, Inc.
7300 WEST WILSON AVENUE • CHICAGO 31, ILLINOIS
Pioneers in Pressure-Sensitives for Advertising and Labeling

See how leading manufacturers are using efficient, economical KLEEN-STIK Labels—write on your letterhead for free samples!

CAMERA MANUFACTURERS CHOOSE ROYALITE

...and produce cases of functional beauty

U. S. Royalite has been tried and proven for years in Revere Camera's top line of projectors. And now, Revere has introduced a moderately priced line strikingly styled with a Royalite case—the Wollensak as pictured here with a Revere executive. Revere's engineers have found—as have many imaginative camera designers—that this tough thermoplastic sheet forms easily to any shape in sharp detail—on low-cost tooling. Beautiful colors and textures are built in permanently. Versatile U. S. Royalite (the industry's standard for A.B.S.* plastics) is now being used in thousands of different applications—from refrigerator truck paneling to automobile interiors. Find out how the functional beauty of U. S. Royalite can benefit *your* product. Write for information.

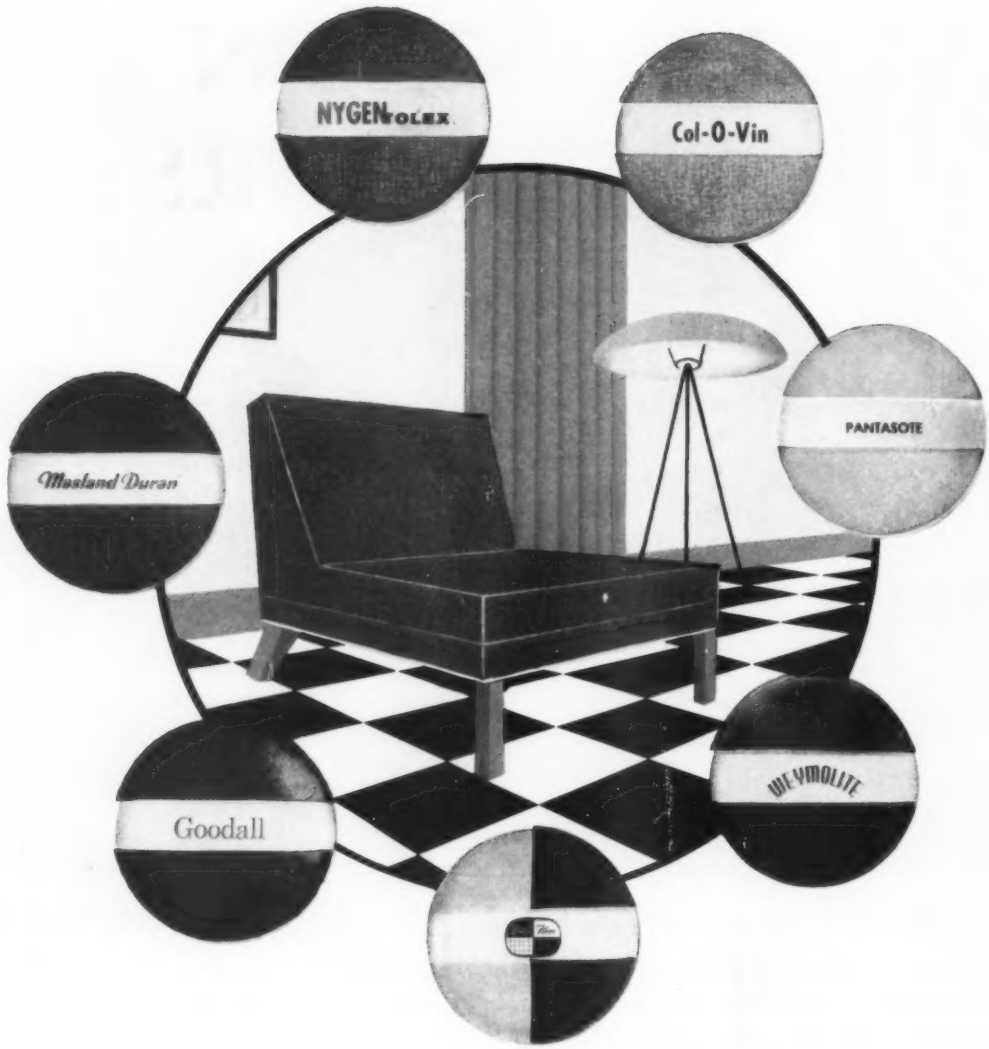
*acrylonitrile, butadiene and styrene

US RUBBER Royalite® NITRILE THERMOPLASTIC SHEET

US RUBBER **United States Rubber**

2638 NORTH PULASKI ROAD, CHICAGO 39, ILL.

the finest vinyls



THANKS TO VERSATILE VINYL FABRICS
MODERN FURNITURE NOW WEARS LONGER, LOOKS BETTER!

are made with

PLASTOLEIN® PLASTICIZERS

A big part of the vinyl plastic fabric you see on furniture in today's homes, offices, and stores is made by the famous names at left. These are the coated fabrics that are the most tailorable...the most durable...meeting every standard for style and appearance. They are the highest possible quality because nothing is spared in choosing raw materials to produce them.

That is why leading manufacturers use Emery Plastolein Plasticizers. They want to make sure they have the extra quality that makes fabrics perform so well, for so long.

If *you* are interested in producing high quality sheeting, coated fabrics, film and extrusions, you *too* should use Plastolein Plasticizers in your plasticizer system. The coupon below will bring you all details about the outstanding permanence of Plastolein 9720 Polymeric, the unsurpassed low-temperature performance of Plastolein 9058 DOZ, as well as data on other Emery Plastolein Plasticizers. Mail it today.

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Organic Chemical Sales Department

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Please send me the 32-page Emeryfacts titled, "Plastolein Plasticizers."

Name.....Title.....
Firm.....
Address.....
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Exact Weight Precision Scales for the Plastics Industry

WEIGHING MACHINE for injection molding

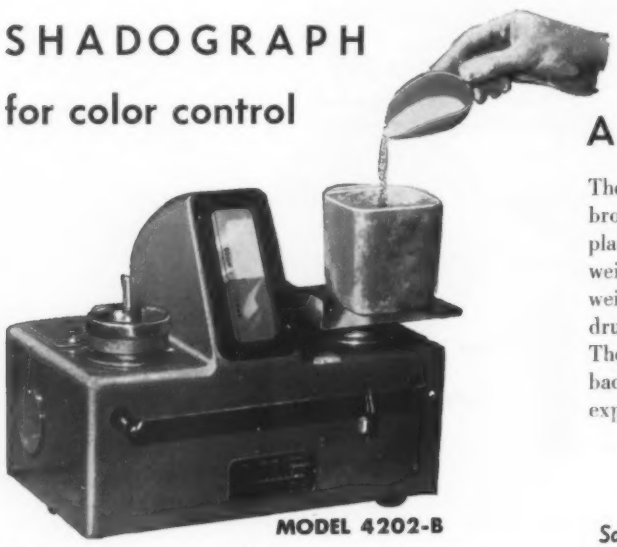
With approximately one thousand Exact Weight Precision Weighing Machines in use throughout the industry, leading molders report savings on material, elimination or reduction of rejects, faster molding cycle and improved quality of molded parts.

Operation of the Weighing Machine is fully automatic. The New Automatic Plunger Position Control is effective in either starve or cushion feeding with visible weight indication on every charge.

The 1:1 ratio lever system, in a complete precision scale with over-under indication, provides extreme accuracy. Double controls cut off feed to scale following all vibration in the press—no material shakes from feeder pan following cut-off. Air-operated weight bucket eliminates all impact to scale. Fine adjustments, 1/100 oz. or 1/4 gram increments, can be easily made. (Avoirdupois or metric system optional at no extra cost.)

MODEL 610-F-00-IM-2

SHADOGRAPH for color control



MODEL 4202-B

The Shadograph is engineered on a design principle utilizing a projected light beam. The result is fast, ultra-visible weight indication without parallax readings. Weighs accurately in out-of-level positions. Capacities from one gram to 100 pounds. Write for Bulletin 3333.

A model for every need

The models shown on this page represent only two from the broad line of Exact Weight Scales made specifically for the plastics industry. They include specialized models for pre-weighing plastics materials for pre-form production, check-weighing pre-forms, counting parts by weight, bagging and drum filling, color blending, weigh feeding.

These scientific cost and quality control instruments are backed by more than 40 years of industrial scale building experience. Write for complete information.

Sales and Service from Coast to Coast

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THE EXACT WEIGHT SCALE CO.
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Exact Weight SCALES

BETTER QUALITY CONTROL . . . BETTER COST CONTROL

Blaw-Knox designs for Goodyear...

mammoth expansion creates the world's largest synthetic rubber plant

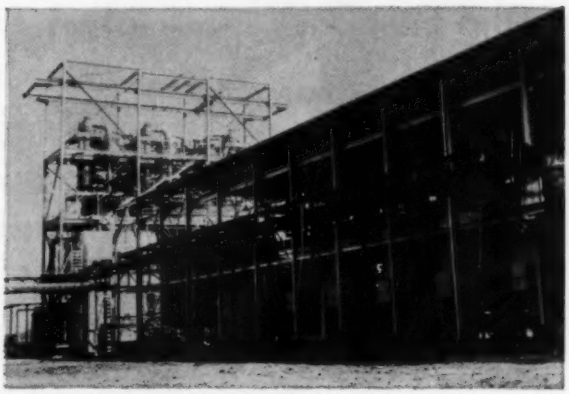
Designed by Blaw-Knox, this $10 million expansion boosts capacity at Goodyear's Houston synthetic rubber plant to 220,000 long tons a year. With this 50% increase in output, this plant becomes the world's largest single producer of dry type synthetic rubber.

Goodyear and Blaw-Knox have been doing big things together for over fifteen years—from Goodyear's first monomer purification facilities to the current construction of the first synthetic rubber plant in Great Britain.*

Repeat business in many diversified fields occurs regularly at Blaw-Knox. But this kind of *continuous endorsement* is not easily earned. It takes solid engineering skill and broad technical experience to assure results that win future assignments.

To see how this endorsed know-how can help you with your plans for erection, expansion or modernization of your plant, contact Blaw-Knox.

*A facility owned in part by Goodyear Tire & Rubber Co. (Great Britain), Ltd.



Two lines of reactors—each containing 11-5,000 gallon reactors along with three stripping columns form the heart of new plant expansion.

BLAW-KNOX

BLAW-KNOX COMPANY

Chemical Plants Division • Pittsburgh 22, Pa. • Chicago 1, Ill.

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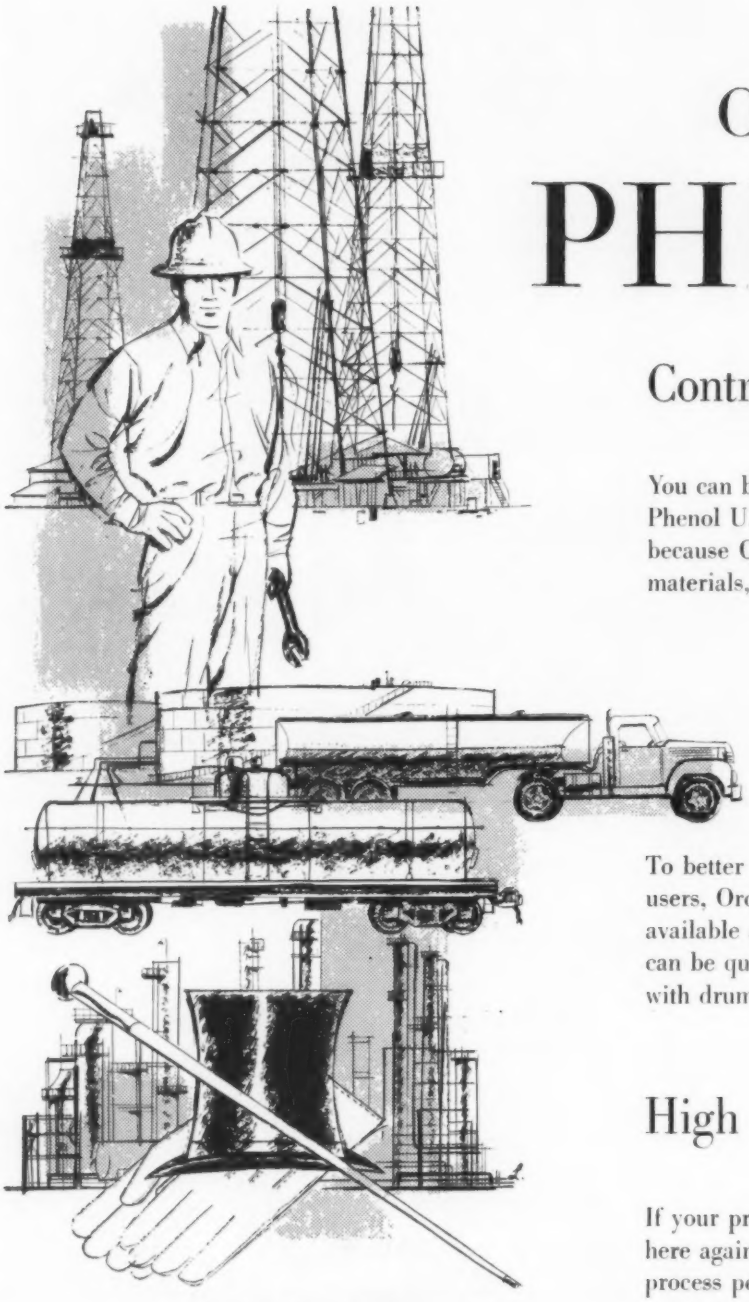

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PHENOL

Control of raw material

You can be assured of Oronite as a dependable Phenol U.S.P. source, now and years ahead, because Oronite has complete control of raw materials, starting with crude petroleum stocks.

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To better serve Eastern and Midwestern Phenol users, Oronite has bulk distribution terminals available at key consuming points. Consumers can be quickly served by tank car, tank truck or with drum shipments.

High quality

If your process requires a highly pure product, here again Oronite's advanced manufacturing process permits consistent high quality Phenol to meet your requirements.

ACETONE

Oronite Acetone is co-produced with Phenol in the world's most modern plant, employing the newest manufacturing process and equipment. Unsurpassed in quality, Oronite Acetone is available nationwide in tank cars, tank trucks and drums.

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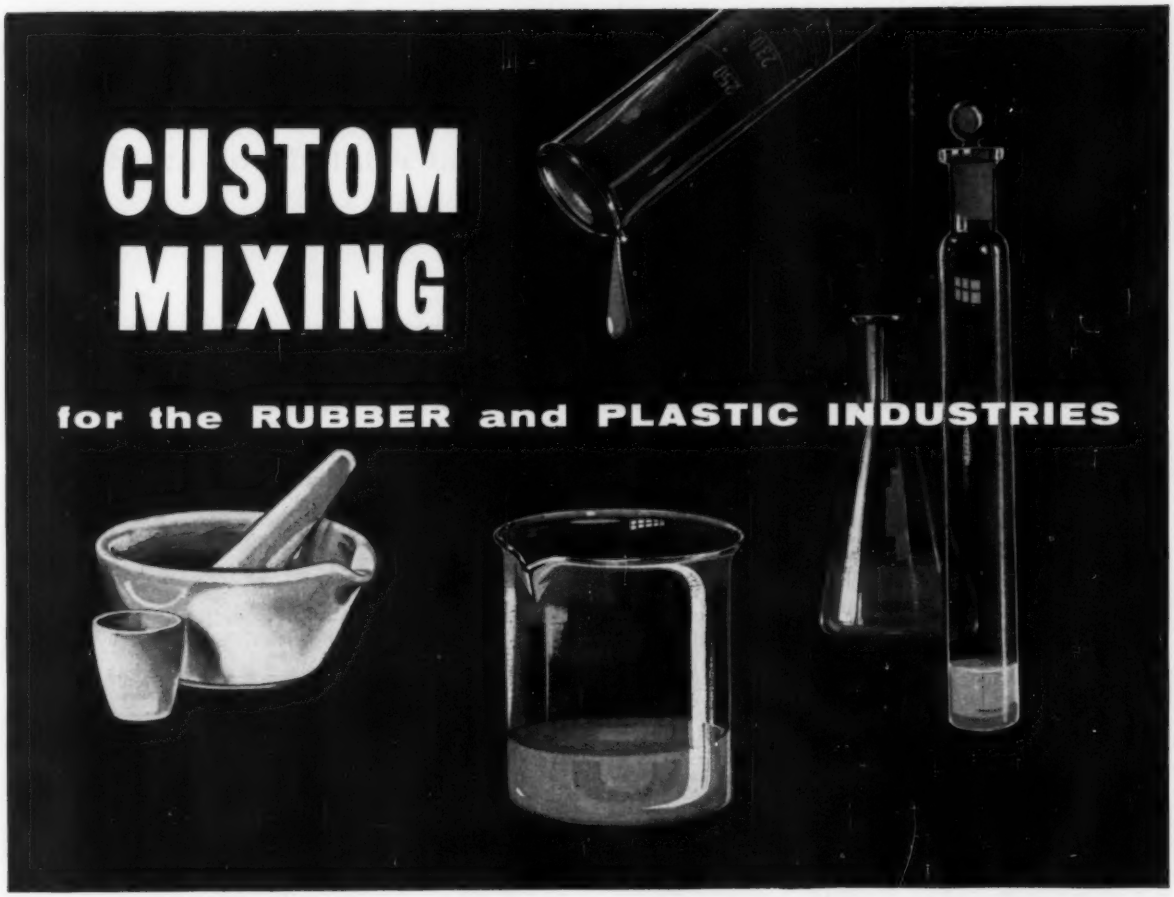

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Through the use of our service you can effect savings by:

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- **BUYING INGREDIENTS AT OUR CARLOAD PRICES**
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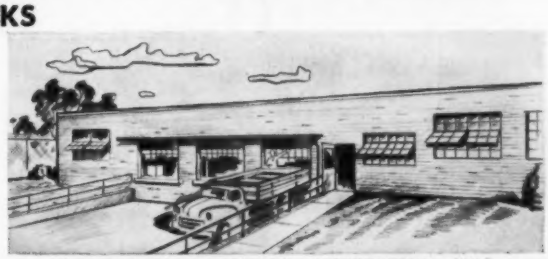
Write, wire or telephone our Barberton, Ohio plant for complete information concerning your milling and compounding problems.



CUSTOM MIXING ADDITION IN BARBERTON, OHIO

MIDWEST RUBBER RECLAIMING CO.

CUSTOM MIXING DIVISION • BARBERTON, OHIO

High compatibility with many resins

Grease and oil resistance in resins

Improved flexibility in nylon and related polyamides

Better adhesive qualities in polyvinyl acetate

ONLY SANTICIZER 8 GIVES

SANTICIZER 8

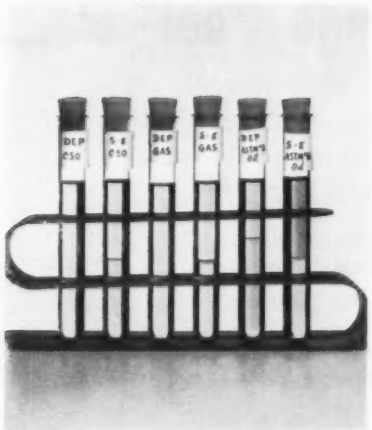
Resin	Maximum Compatibility PHR*	Outstanding Properties and Characteristics
Cellulose Acetate	90	High brilliance and gloss. Good water, grease, and scuff resistance.
Phenolic Resins	50	Slight flexibility. Improved punching characteristics for laminates.
Acrylic Resins	25	
Cellulose Acetopropionate	100	High compatibility.
Nitrocellulose	80	Excellent moisture and grease resistance, flexibility and adhesion in lacquers.
Polyvinyl Acetate	100	High adhesion, grease resistance and flexibility.
Ethyl Cellulose	60	
Polyvinyl Butyral	100	
Shellac	40	High adhesion and flexibility.
Santolite Resins	50	Combinations with Santicizer 8 excellent in nitrocellulose lacquers.
Protein Compounds	50	In Zein, S-8 improves flexibility, water resistance, gloss and adhesion.
Melamine Resins	50	Slight flexibility. Improved punching characteristics for laminates.
Nylon and Other Polyamides	high	Flexibility at room and low temperatures. Reduces processing temperatures.
Casein	65	Flexibility, scuff, and grease resistance.
Allyl Starch	20	Grease and scuff resistance.

*PHR—Parts of plasticizer per hundred of resin

1. High compatibility with many resins.

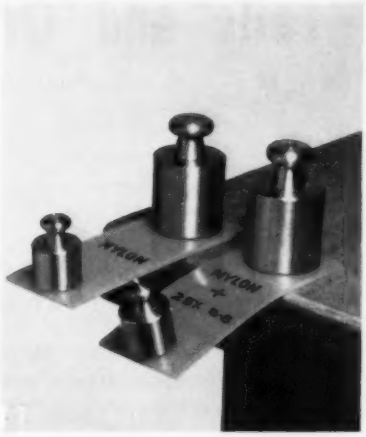
As this listing shows, Santicizer 8 is an unusually versatile primary and secondary plasticizer.

YOU ALL THESE ADVANTAGES



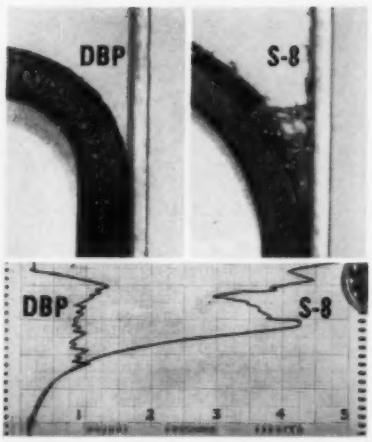
2. Grease and oil resistance in resins

Santicizer 8 is practically insoluble in aliphatic hydrocarbons. The miscibility test above compares the resistance of diethyl phthalate and Santicizer 8 against cottonseed oil, gasoline, and ASTM #3 oil. Santicizer 8 (in the second, fourth and sixth test tubes) proves much superior. Santicizer 8 and nitrocellulose plus Monsanto Santolite resins produce lacquers that are unaffected by gasoline, fats and oils.



3. Improved flexibility in nylon and related polyamides

Santicizer 8 is one of the best plasticizers known for synthetic polyamides such as nylon and related resins. By extending these resins, it lowers cost. It also lowers melting point, improves toughness and flexibility — especially low-temperature flex—without adversely affecting other properties. The more flexible nylon sheet shown above is nylon with 25% Santicizer 8.



4. Better adhesive qualities in polyvinyl acetate

In polyvinyl acetate, Santicizer 8 produces stable adhesives with good adhesion and flexibility. The test above shows the better rubber-to-metal adhesion of polyvinyl acetate with Santicizer 8 over that with dibutyl phthalate. Santicizer 8 also imparts excellent adhering properties to polyvinyl-acetate hot melts for bookbinding and shoe adhesives.

Want to improve any of these products?

Grease-resistant paper; lacquers and other coatings that resist gasoline, oil, other petroleum products . . .

Nylon and related resins . . .

Adhesives for bookbinding, shoemaking, binding rubber to metal . . .

Laminates . . .

Our Technical Service Department will help you test Santicizer 8 in your operation. Monsanto supplies almost FIFTY different plasticizers of SEVEN basic types. Call on Monsanto for one-stop service, mixed bulk shipments at bulk prices, and expert technical advice.

With no vested interest in any single plasticizer, Monsanto develops plasticizing systems tailor-made to fit your needs.

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WHERE CREATIVE CHEMISTRY
WORKS WONDERS FOR YOU

How would you complete this sentence?

"Tails" and "Orange Peel" are...

☐ **A** —Ingredients in a witch's brew—to be combined with the heel of an eel, the eye of a fly, and a smidgin of pigeon.

☐ **B** —Something cooked up for a fellow with a mighty strange appetite.

☐ **C** —Unrelated items. Crafty old Boonton posed the question just to sidetrack everyone into a discussion of their compression and injection custom molding service.

☐ **D** —Nicknames for surface defects found in plastics moldings.

☐ **E** —None of these.

"D" is the correct answer. "Tails" are streaks or tears in the surface of a molding. They're caused when the molding material flows improperly over or around raised surfaces in the mold, such as letters or numerals. "Orange peel" is a rippling of the surface, generally caused by improper molding conditions.

There are lots of other surface flaws that can mar the appearance of a piece, too. As well as some invisible defects inside the piece that can have a damaging effect on product performance. A molder who knows the score can adjust his equipment and select his materials to remedy these situations. *Boonton's* been doing just that for the past thirty-five years. That's why our customers receive their moldings . . . free from defects.

BOONTON MOLDING CO.
BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
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AMOCO Oxo Alcohols
highest esterification quality

AMOCO Chemicals' Oxo Alcohols have established a new criterion in esterification quality.

To vinyl plastic compounders this means: Lighter color, more stable phthalate plasticizers.

To esterifiers this means: The best raw material available, highest quality finished ester, improved yield, and savings in both time and materials through reduced decolorization requirements.

How can AMOCO Chemicals assure you of this new criterion of esterification quality? Because tests at the plant evaluate the alcohol in terms of esterification quality. Tests accurately simulate ester manufacture, and correlate with manufacturers' experience.

Get more facts about AMOCO Chemicals' Oxo Alcohols. Your inquiry will bring an immediate reply.

AMOCO CHEMICALS CORPORATION
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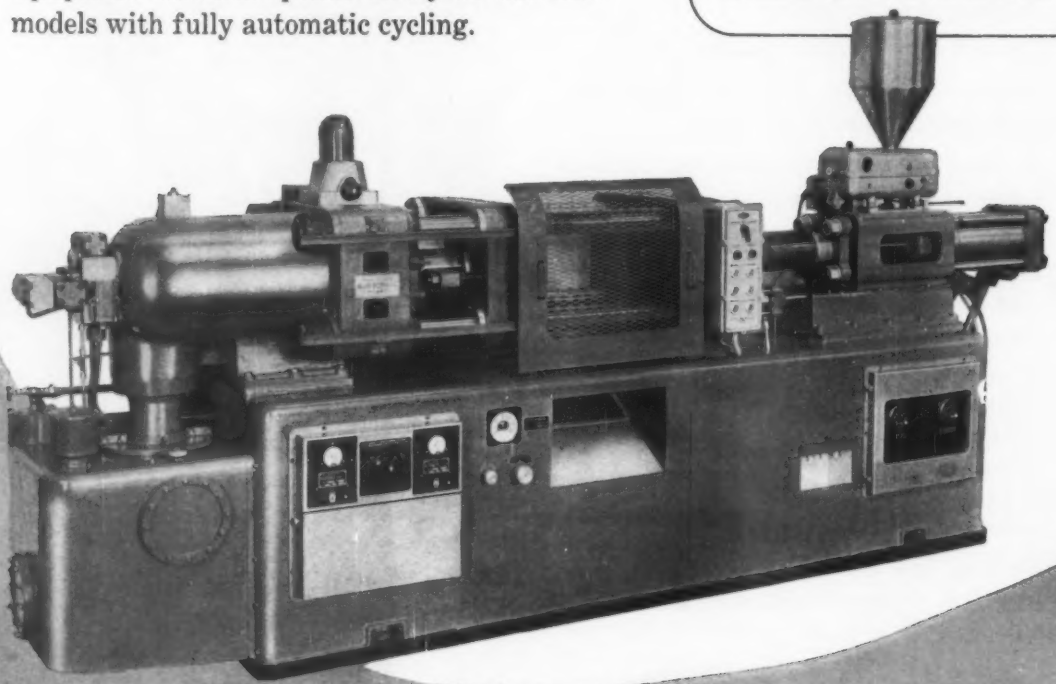
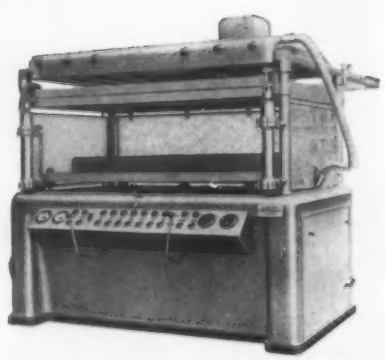
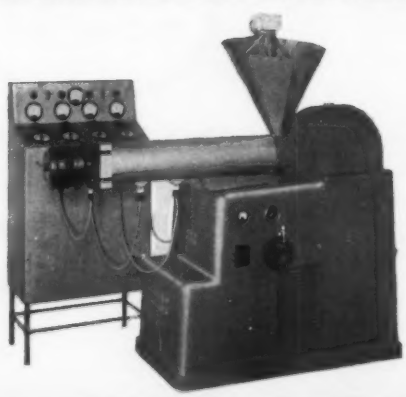
This is the age of automation and Negri Bossi automatic machines lead the way. Negri Bossi equipment features special safety devices and models with fully automatic cycling.

R. 12 F.A. Fully automatic injection press – capacity 4 to 6 oz. – fast operating cycles (8 shots a minute)





VUOTOPLAST Vacuum Forming Machines



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For clearer clears, for brighter bright colors in vinyl film and sheeting...

New "Dutch Boy" Stabilizers

"Dutch Boy" research has done it again.

This time with two *new* stabilizers, outstanding for:

① **clarity**
② **economy**
③ **easy use**

One of these new "Dutch Boy" stabilizers, Flomax* 25 is a barium-cadmium organic. It's the one to give clears, vivid blacks, or colored translucents extraordinary heat and light stability. It contributes extremely high resistance to yellowing and to plateout.

The other, "Dutch Boy" Nalzin*, is an equally remarkable zinc organic co-stabilizer. When stain resistance is a must, Nalzin replaces a portion of the barium-cadmium organic.

Both of these stabilizers protect clarity and color during processing. Both prolong these values during product use.

Economical to Use

In cost, in efficiency, both Flomax 25 and NALZIN are the improvements you've been looking for.

They're easy to incorporate, as well . . . liquid, miscible in and compatible with common plasticizers and solvents, ideal for calendered resins.

If you make stocks for shower curtains, tablecloths, luggage, upholstery, pocketbooks and the like, get a rundown on Flomax 25 and Nalzin. And on four other "Dutch Boy" non-lead Stabilizers for stocks of this type. Write for the new "Dutch Boy" Stabilizer Handbook.

*Trademark

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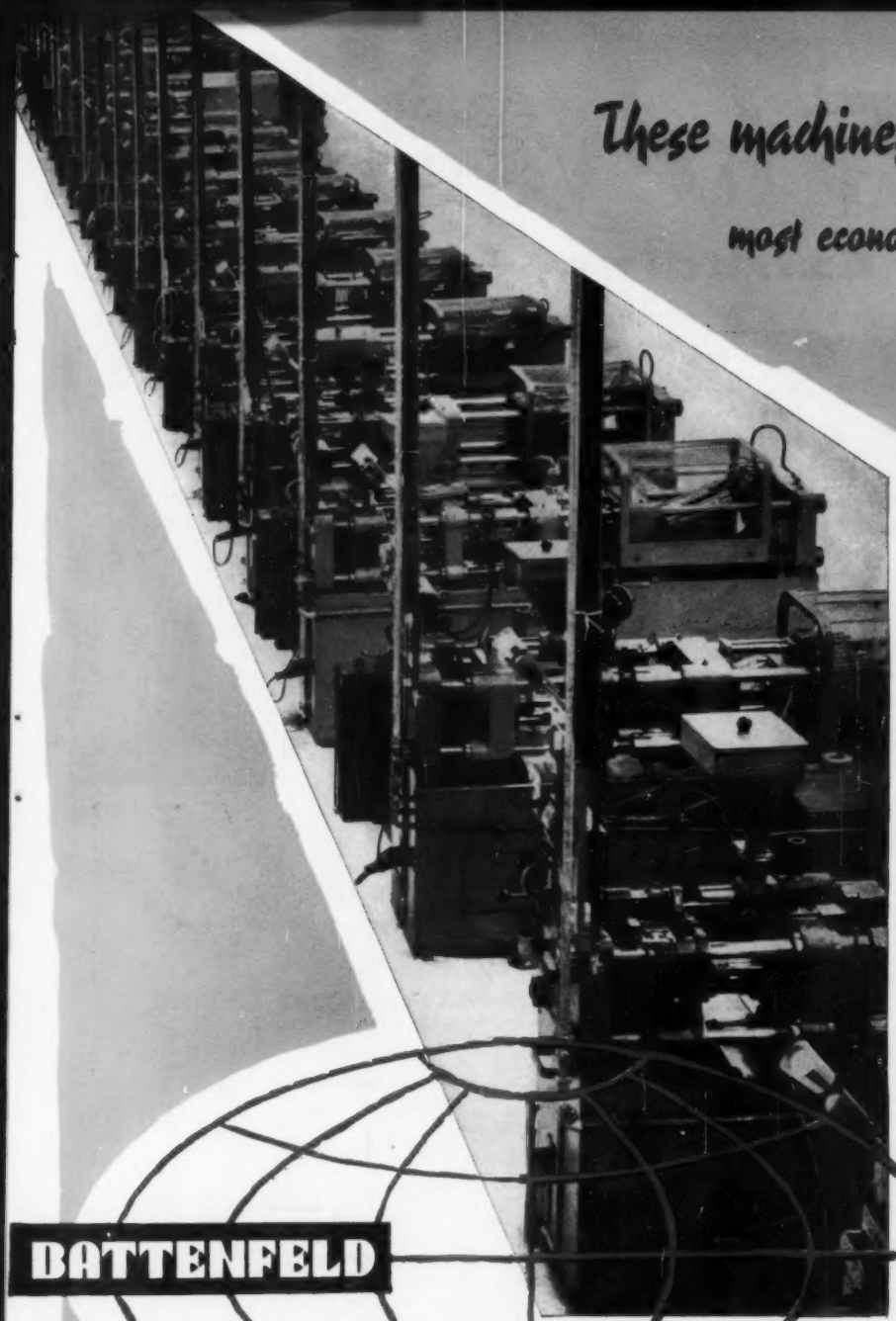
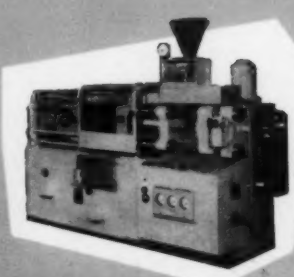
These machines give most economical production



The fully automatic operation, simple electro-mechanical design with an amazing record of quality maintained over long production runs at lowest initial and lowest operating costs are the outstanding characteristics of BATTENFELD INJECTION MOLDING MACHINES

BATTENFELD



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your 5 keys to better Molding, Extruding, Calendering

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HIGH IMPACT THERMOPLASTIC RESIN

Already used extensively in a host of end-use products, Cycolac now provides an easy solution to many product cost and quality problems. With added scientific refinements, Cycolac offers five types, each designed to serve specific requirements.

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NOW! 5 TYPES FOR MORE SPECIFIC END-USE APPLICATIONS

TYPE R Especially suited to parts requiring maximum hardness, *rigidity*, tensile strength, resistance to heat-distortion.

TYPE T Excellent for use in items where greatest *toughness* at high hardness and tensile-strength levels is essential.

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TYPE L Extensive applications in extruded pipe and tubing . . . intricate profile extrusions . . . calendered sheet. Low brittle point.

TYPE LT Exceptional *low temperature* properties; non-brittle even in sub-zero temperatures. Applications include miscellaneous extrusions, calendered sheet.

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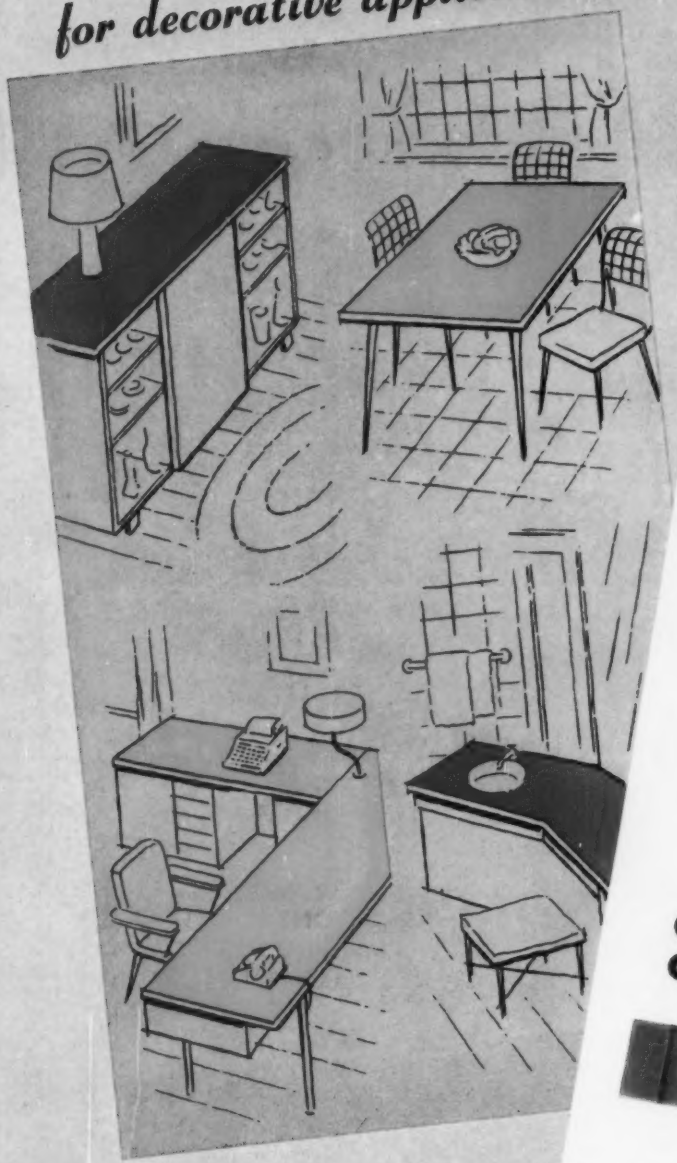
Marbon®

for decorative applications



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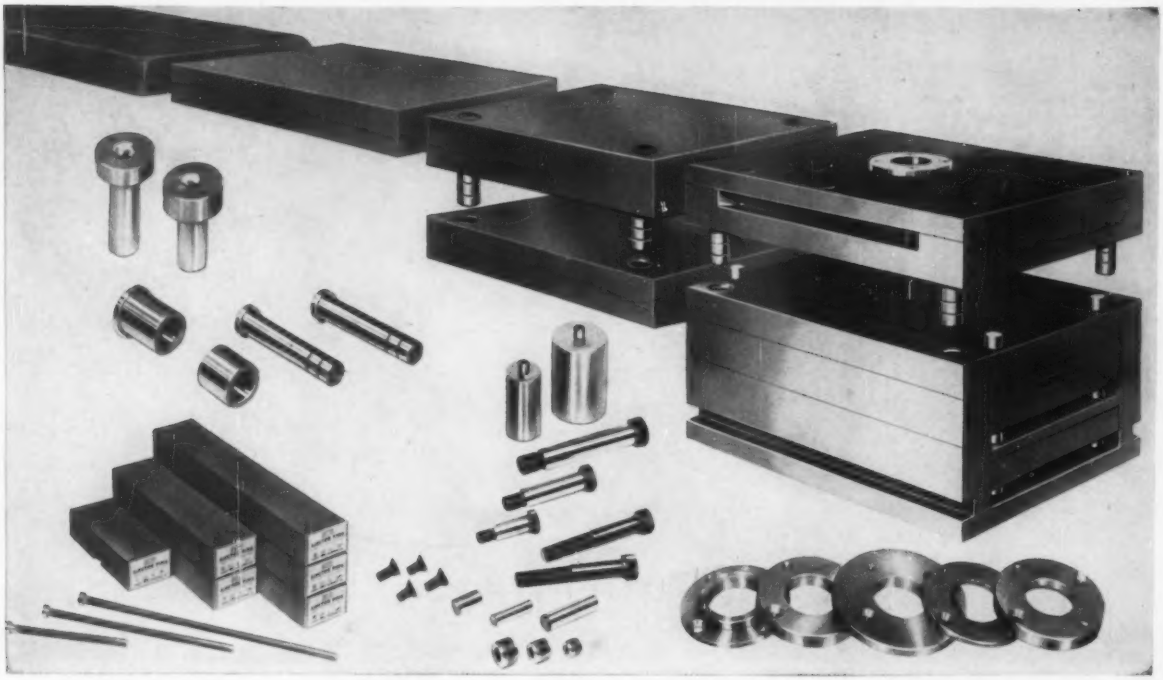


PROGRESS THROUGH STANDARDS

. . . and how DME "helped"

The history of economy in modern business has been directly related to the history of Standardization. One of the major elements affecting the economic production of finished plastic parts is the high initial cost of the mold. A progressive step in reducing mold cost, without sacrificing the high quality required, has been successfully achieved through Standardization.

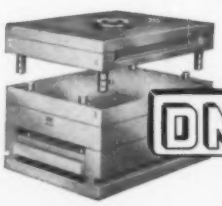
When D-M-E originated Standard Mold Bases and their component parts in 1942, it provided the answer to the rapidly growing demand for high quality molds that would maintain and promote the economic advantages of plastic parts.

Through large volume purchases of quality steel in standard sizes and specialized production facilities, D-M-E was able to produce and supply high quality Standard Mold Bases to mold makers and molders at such great savings in cost and time that the benefits of Standardization were quickly realized by the Industry.

Today D-M-E produces twenty-two different sizes of Standard Mold Bases, from 9″ x 8″ to 18″ x 35½″, in either D-M-E No. 1 or No. 2 Steel, with a wide range of cavity plate thicknesses to satisfy the diversified demands required. In addition, over 2,000 finished component parts of the same high quality are available to provide additional savings in service as well as in the product.

Properly engineered Standardization puts the accent on Economy. When you "Specify D-M-E . . ." you get Quality, Service AND Economy!

Specify **D-M-E**
for
QUALITY . . .
SERVICE . . .
ECONOMY!



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Contact Your Nearest Branch FOR FASTER DELIVERIES!

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Check and double check! That's the motto of our modern color laboratory that serves as *your* quality control right in our plant. The lab works for you in three important ways.

First, it blends and develops Ferro Colors for your specific applications and materials. Colors that meet your specifications for color shade, dispersion and other qualities.

Second, our lab checks every shipment of your colors against your standards *under production conditions!* Actual samples are produced and checked for color match and uniformity.

Third, Ferro is continually testing and experimenting to develop new colors and to adapt present colors to new plastic materials. We also help you with technical data and application information on new methods for coloring clear resins in your own plant.

Ferro Dry Coloring techniques for all types of plastics, and Paste Coloring techniques for polyester and epoxy resins, have reduced raw material costs and eliminated waste and storage problems for many producers.

These are just three reasons why more and more molders, extruders, and other plastic producers are standardizing on Ferro Colors. Write us today for samples and information on how Ferro High Fidelity Color Service can help you!

FERRO CORPORATION
Color Division
4150 East 56th Street • Cleveland 5, Ohio

5309 South District Boulevard, Los Angeles 22, California Ferro Enamels (Canada) Ltd., Oakville, Ontario, Canada
Foreign plants in Argentina, Australia, Brazil, Chile, England, France, Holland, Japan, Mexico, South Africa

NEW Ferro Stabilizer Systems Improve Plastisol Production

For all plastisol processes, Ferro Stabilizer Systems will improve product quality, reduce rejects and minimize production headaches.

These systems have been designed to give controlled viscosities and good air release. The stabilizers have been developed to provide an optimum balance of heat and light stability with good color retention . . . and do it at *low cost!* Ferro Stabilizer Systems also give you high clarity and sulfur stain resistance where such qualities are required.

Whether you are molding boots, toys, auto parts or other plastisol products by dip, rotational or slush molding methods, these New Ferro Stabilizer Systems can reduce production problems and increase product service life. Write, wire or call collect* today for samples and technical data.

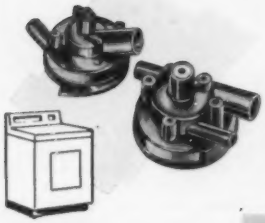
FERRO VINYL STABILIZERS

Ferro Chemical Corporation • Bedford, Ohio

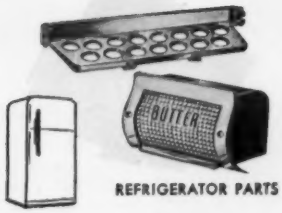
A SUBSIDIARY OF FERRO CORPORATION

In Great Britain and on the continent (except Germany) Ferro Vinyl Stabilizers are manufactured and distributed under license by PURE CHEMICALS LTD., Kirkby Industrial Estate, Liverpool, England.

*Call collect . . . for samples, technical data or assistance on vinyl formulation or production problems. Call Cleveland, Ohio, BEdford 2-5320, Ferro Technical Service Department and *reverse the charges!* No obligation, of course!



WASHER AND DRYER PARTS



REFRIGERATOR PARTS

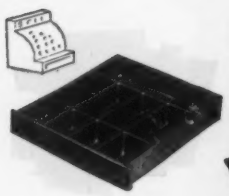
RADIO CABINETS

GOVERNMENT WORK

NOW...TWO modern plants to produce your custom molded plastics *Efficiently... Economically... On Time!*

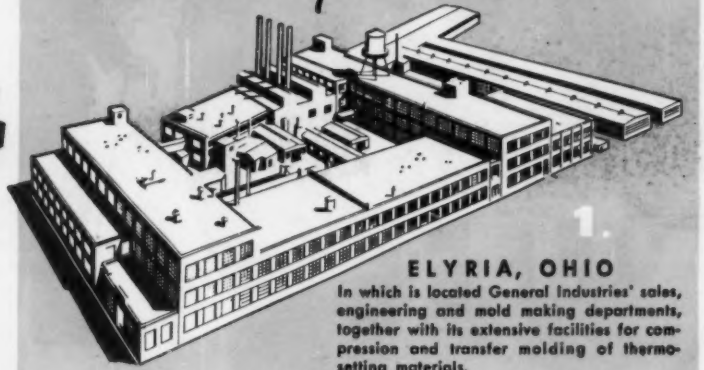
APPLIANCE HANDLES

VACUUM CLEANER NOZZLES



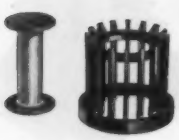
CASH REGISTER DRAWERS

CASTERS

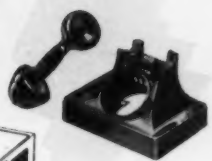


1. ELYRIA, OHIO

In which is located General Industries' sales, engineering and mold making departments, together with its extensive facilities for compression and transfer molding of thermosetting materials.



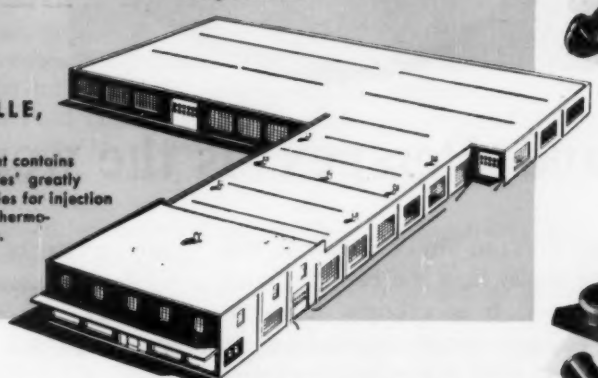
TEXTILE MACHINERY PARTS

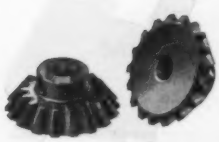


TELEPHONE SETS

2. MARYSVILLE, OHIO

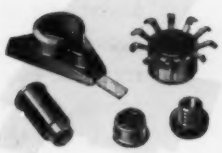
This modern plant contains General Industries' greatly expanded facilities for injection molding of all thermoplastic materials.





INDUSTRIAL GEARS

...it pays to RELY on GI!



ELECTRICAL PARTS

- **COMPLETE ENGINEERING SERVICE**
- **COMPRESSION MOLDING** 150 presses ranging up to 1850 ton capacity.
- **INJECTION MOLDING** 17 presses ranging up to 200 oz. capacity.
- **FINISHING EQUIPMENT** Automatic facilities include equipment for trimming, polishing, buffing, drilling, tapping, tumbling and painting.
- **MOLD MAKING FACILITIES** General Industries' own tool and die shop is capable of producing all types of high quality custom molds and dies.

THE GENERAL INDUSTRIES CO.

PLASTIC DIVISION • ELYRIA, OHIO

Part of a large display sign, internally lit at night, made from 'Perspex' by Pearce Signs Ltd. for the Branch office and depot of Edward Sharp and Sons Ltd. at Audenshaw, Manchester. The parrot (8 ft. 9 ins. high) is made from pieces of coloured 'Perspex' fitted together like a mosaic and on the 6 ft. diameter opal 'Perspex' circle the red letters are 2 ft. and 18 ins. high.

...and 'Perspex' is the word for signs!

'PERSPEX' ACRYLIC SHEET makes the best advertising display signs and has many other decorative uses. It is a bright, handsome material, extremely tough, light and easy to handle, and will stand up to weather conditions in any part of the world.

'Perspex' signs are busy selling goods and services all over the world, all day and every day – and often far into the night. Because 'Perspex', in its transparent or translucent form, is ideal for illuminated displays.

'Perspex' is available in clear or opal sheet or in a wide range of transparent, translucent and opaque colours.

'PERSPEX'

'PERSPEX' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

IMPERIAL CHEMICAL INDUSTRIES LIMITED
PLASTICS DIVISION: EXPORT DEPT., BLACK FAN ROAD, WELWYN GARDEN CITY, HERTS.

U.S.A. enquiries to: J. B. HENRIQUES INC., 521 FIFTH AVENUE, NEW YORK 17, N.Y.
Canadian enquiries to: CANADIAN INDUSTRIES LTD., PLASTICS DEPT., BOX 10, MONTREAL, P.Q.

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Large diameter tubing and cables are no problem with . . .

DAVIS-STANDARD ROTATIVE CROSSHEAD EXTRUDERS*

Another Davis-Standard exclusive!
The Rotative Crosshead Extruder solves the problem of poor distribution of compound around the core tube. The internal design of the Rotative Crosshead creates a uniform flow of compound over and under the core tube to eliminate low pressure areas.

Even Wall Thickness around the entire circumference of both tubing and cable insulation.

"Knit Marks" caused by core supports and low compound pressure are reduced to an absolute minimum.

Uniform Coverage is assured throughout entire length of cable or tubing.

The **ROTATIVE CROSSHEAD EXTRUDER** is available in many sizes from 1½ inches I.D. to approximately 6 inches I.D. Excellent results have been obtained on practically all rubber and synthetic rubber compounds and most thermoplastic materials now being extruded.

*U. S. Patent No. 2794213

D-S MYSTIC CONNECTICUT U.S.A.

DAVIS-STANDARD

Division of FRANKLIN RESEARCH CORPORATION

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BENZOGUANANAMINE

solid . . . reactive . . . aromatic diamine . . .
non-volatile . . . relatively non-toxic
and non-irritating

TENNESSEE announces benzoguanamine . . . a member of the triazine family with characteristics that offer outstanding benefits in product improvement and lower costs.

Comparison to melamine: A substituted melamine with two reactive amino groups plus a non-reactive phenyl group per molecule, as shown in structure above. (Melamine has three reactive amino groups.) Reacts with formaldehyde and alcohols to form a wide variety of triazine resins. Can be processed with the same equipment and techniques as used for melamine. Compared to melamine, resins based on benzoguanamine have improved compatability, water resistance, color retention, initial gloss, and alkali resistance.

Applications: Formulation of resins for industrial coatings, molding compounds, adhesives, paper products, and textile finishes. As a chemical intermediate, benzoguanamine contains two reactive amino groups attached to a stable triazine ring.

Physical properties: Molecular weight 187.2 . . . Freezing point 227°C . . . Full details in Technical Data Bulletin; free on request.

Available in commercial quantities. Experimental samples will be forwarded when requested on company letterhead.

TENNESSEE
PRODUCTS & CHEMICAL
Corporation
NASHVILLE, TENNESSEE

A DIVISION OF THE CHEMICAL, PAINT AND METALLURGICAL DEPARTMENT OF MERRITT-CHAPMAN AND SCOTT CORPORATION

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A WORLD OF EXPERIENCE

. . . goes into every Consolidated product. From blueprint to delivery, each plastics part is in the hands of skilled technicians to whom a customer's "well done" is the ultimate goal. Why don't you let us demonstrate what this experience and service can mean to you? You'll like the extra touches that mark a job by Consolidated.

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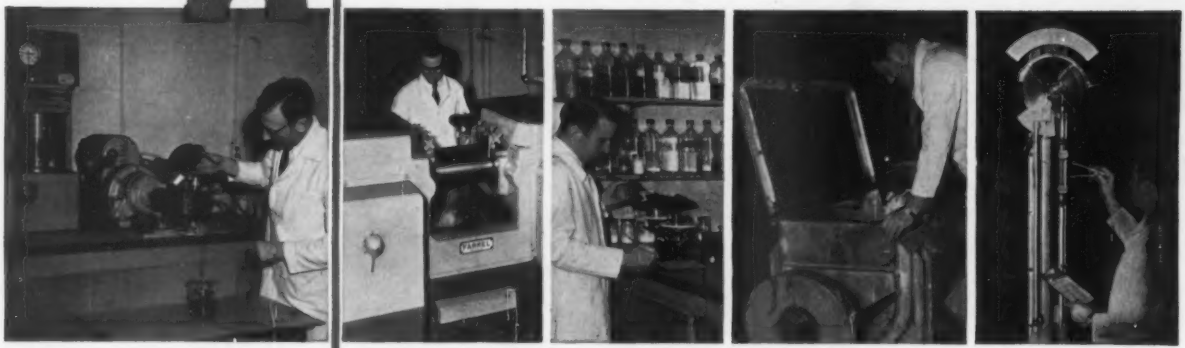
SCRANTON 2, PA.

A. Schulman, Inc. answers today's biggest plastic question . . .



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LABORATORY CONTROLLED

processed vinyl and polyethylene?

Because they're saving money. Our processed vinyl and polyethylene DO cost less, but at the same time, precise laboratory control assures a product of the highest quality. Working with modern methods and machines, we are able to fill your raw material orders to EXACT specifications, at definite savings to you. HOW?

We maintain complete laboratory equipment of the very latest type, and a staff of highly skilled technicians checks the quality of vinyl and polyethylene we buy, then keeps a constant watch on our processing. Whether you do molding or extruding, we are in a position to handle your requirements . . . just let us know what product you make and give us your specifications.

There is NO GUESSWORK involved — and it COSTS YOU LESS.

Samples mailed on request.

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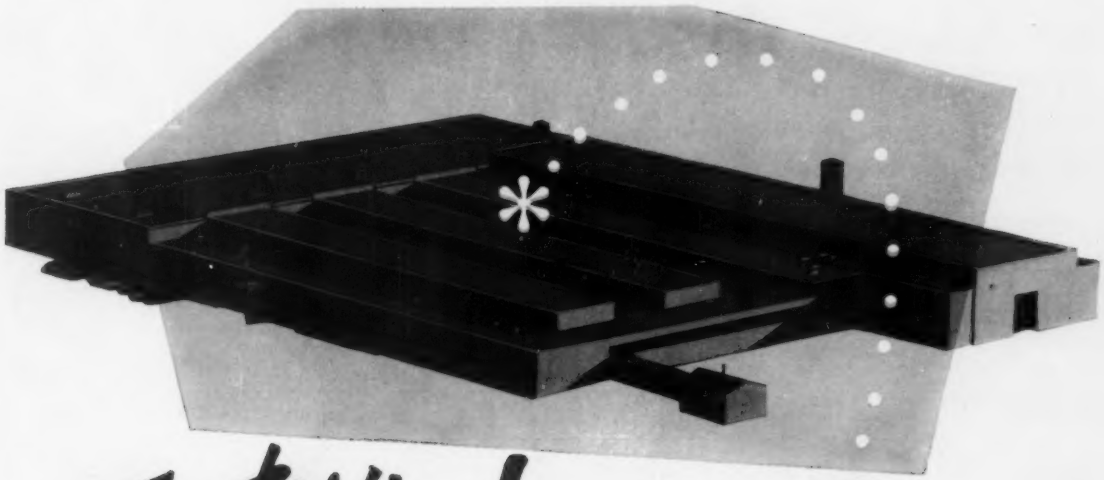


Factory Facts!

about "Your plastics department"*

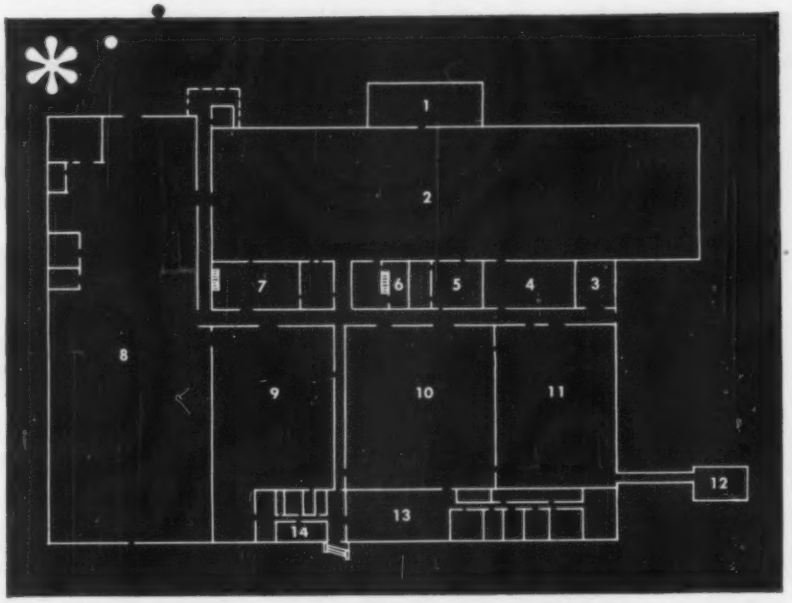
It is a new and complete injection molding plant, from modern tool room to all coordinated departments for supplementary operations such as assembly, decorative painting and printing and special packaging.

The quality and economy born of efficiency in a modern, custom operation are yours in our "start to finish service."

PLANT LAYOUT

1. Boiler and pump room
2. Molding room—32 presses 4 to 80 oz.
3. Air compressors
4. Lunch room
5. Shop maintenance
6. Employees locker rooms
7. Quality control
8. Warehouse and shipping dept.
9. Tool and die shop
10. Finishing and packaging
11. Decorative painting and imprinting
12. Paint and chemical storage
13. General offices
14. Drafting and engineering dept.

Send for our detailed facilities brochure



*MINNESOTA PLASTICS CORPORATION

Injection molders of thermoplastics

45 E. MARYLAND AVENUE ST. PAUL 3, MINNESOTA

adhesives
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typical formulations for THE PLASTICS INDUSTRY

number	principal uses	characteristics	color	base	solvent	viscosity	approx. solids	wet weight per gallon	application
ALT-1105	Vinyl to Fabric, leather, paper	Quick grab, high tack with long tack period	White	Natural Rubber	Water	25-30/200 Stormer	47.1%	8.16#	Spray, brush, roll coat
BLG-890-1	Tie coat for vinyl films	Non-blocking; good adhesion to vinyl and elastomeric pressure sensitive masses	White	Synthetic Rubber	Water	15-18/500 Stormer	44.5%	8.90#	Roll Coater —2 mils dry
SW-523	Temporary folding of vinyl	Long tack period and affinity to vinyl; outstanding number in the manufacture of plastic handbags	Creamy Tan	Synthetic Rubber	Toluol, SRS, Ethyl-acetate	17-19" DuPont	17.0%	7.42#	Brush
SB-505	Plastics to wood, metal; aluminum to glass, metal; lucite to steel	Resistant to most plasticizers	Amber	Synthetic Rubber	M.E.K.	12-14" DuPont	29.74%	7.66#	Brush-wet stick, heat or wet activation
SB-545 SB-550	Vinyl tile Rubber tile	Both numbers feature tenacious water resistant bond	Green Green	Synthetic Rubber	Acetone M.E.K.	Trowel Viscosity	60.0%	9.1#	3/32" notched trowel
SBP-588	Plastics to wood, metal	Heavy adhesive designed for knife coating and later activation	Amber	Synthetic Rubber	M.E.K. Acetone Synasol	*20-25,000 Cps. #3 Spindle @ 4 RPM	42.50%	7.67#	Brush, knife coater

*Brookfield RVF Model

special emphasis recently on ADHESIVES FOR MYLAR*

*MYLAR is DuPont's registered trademark for its brand of polyester film.

Request information on our SB-6300 series for bonding clear or metallized mylar film to itself, to each other or to such substrates as vinyl film, vinyl coated fabrics, paper, metal, rubber, etc.

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Request information on our SW-570 series (elastomeric type) for rigid laminating and sandwich panel construction as well as the vinyl phenolic and epoxy types for sandwiches.

Double-Face* PRESSURE SENSITIVE TRANSFER FILM

PATS. PENDING

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*Trademark of Interchemical Corporation

A new translucent pressure sensitive mass in film form supported by a release paper which can be either removed at once, or at a later date, for instant bonding of two objects.

also serving every industry with latest developments in Rubber, Latex and Resin Cements, Pressure Sensitive Cements, Flocking Cements, Laminants, Sealants, Tie Coats and Resin Emulsions.

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Angier Adhesives

Division of Interchemical Corporation

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Midwestern Plant: Huntington, Indiana

Ask for more information by series number, by product name, or request Angier's General Folder.

Information desired with inquiry:

1. Basic materials involved (supply samples when possible). 2. Service requirements involved such as temperature, stress, toxicity, bond strength, use of solvent, color. 3. Assembly requirements, including drying time, design and joint needs. 4. Application preference, such as spray, dip, grid, knife or brush. 5. Estimated volume needed per month. 6. Price limitations. 7. Government specifications or test standard, where in force.

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MOISTURE BARRIER

coat with

PETROTHENE

POLYETHYLENE RESIN

Details on Back

Polyethylene because of its low cost, high water vapor resistance, and excellent heat sealing properties, is becoming more and more popular for moisture barrier applications. It coats practically everything used for flexible packaging of industrial or consumer items. It adheres tightly to papers, fabrics, films and foils. It adds strength, too.

Petrothene paper coating resins have these advantages over many other polyethylenes . . .

- ✓ **HIGHER PRODUCTION RATES**
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Polyethylene coatings add strength and moisture resistance in packaging

- chemicals
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typical formulations for THE PLASTICS INDUSTRY

number	principal uses	characteristics	color	base	solvent	viscosity	approx. solids	wet weight per gallon	application
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Rubber, Latex and Resin Cements, Pressure Sensitive Cements, Flocking Cements, Laminants, Sealants, Tie Coats and Resin Emulsions.

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For an excellent

MOISTURE BARRIER

coat with

PETROTHENE

POLYETHYLENE RESIN

Polyethylene coating finish may be dull or have a high gloss, whichever is preferred.

Vapor barrier characteristics are the same with either finish.

Details on Back

Polyethylene because of its low cost, high water vapor resistance, and excellent heat sealing properties, is becoming more and more popular for moisture barrier applications. It coats practically everything used for flexible packaging of industrial or consumer items. It adheres tightly to papers, fabrics, films and foils. It adds strength, too.

Petrothene paper coating resins have these advantages over many other polyethylenes . . .

- ✓ **HIGHER PRODUCTION RATES**
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Polyethylene coatings add strength and moisture resistance in packaging

- chemicals
- cosmetics
- drugs
- foods
- hardware
- industrial parts
- machinery
- textiles
- tobacco
- and many others

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I would like more information on PETROTHENE Polyethylene.

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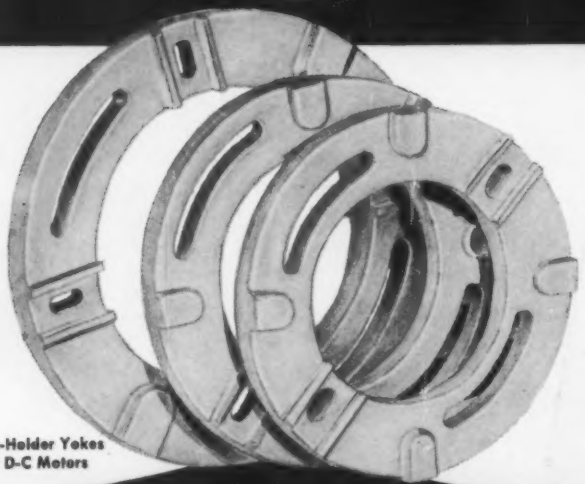
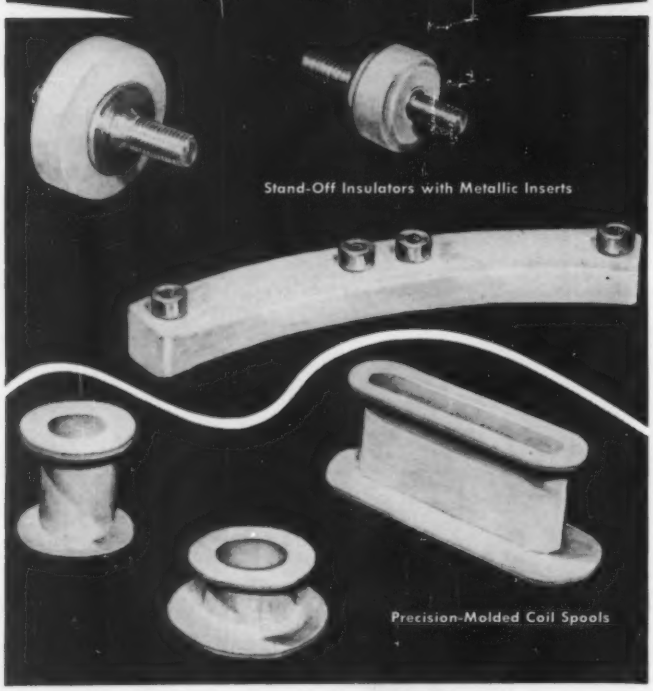


Brush-Holder Yokes for D-C Motors

A few applications of reinforced plastics using Hydrite Kaolinite fillers.



It is not often that a component material can improve the quality of a product and reduce its cost at the same time. Yet that is exactly what Hydrite Kaolinites accomplish when used as fillers in reinforced plastics.

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The advantages of Hydrite Kaolinites are especially pronounced in polyester resins, chlorinated polyester resins, epoxy resins, diallyl phthalate resins and phenolic resins.

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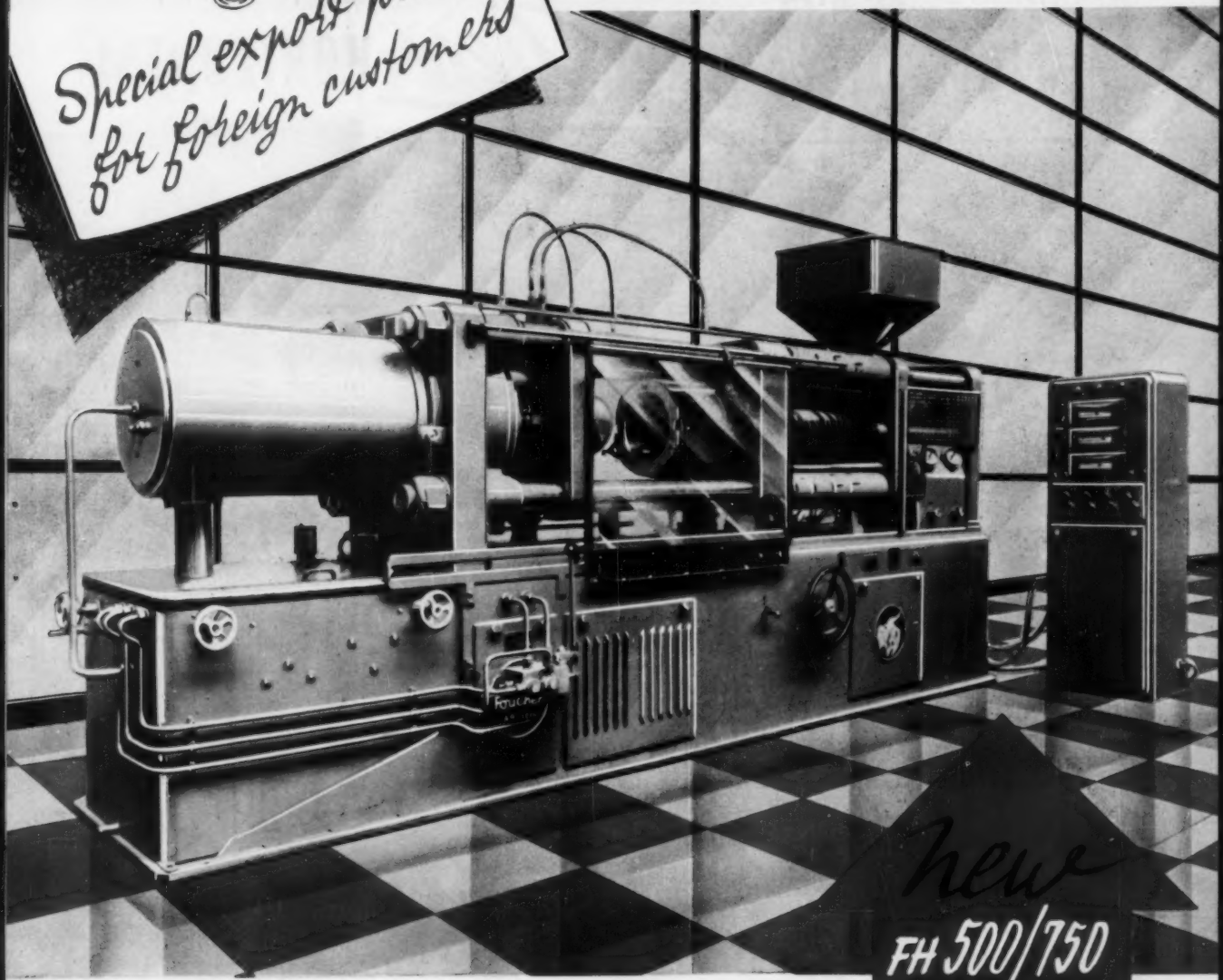

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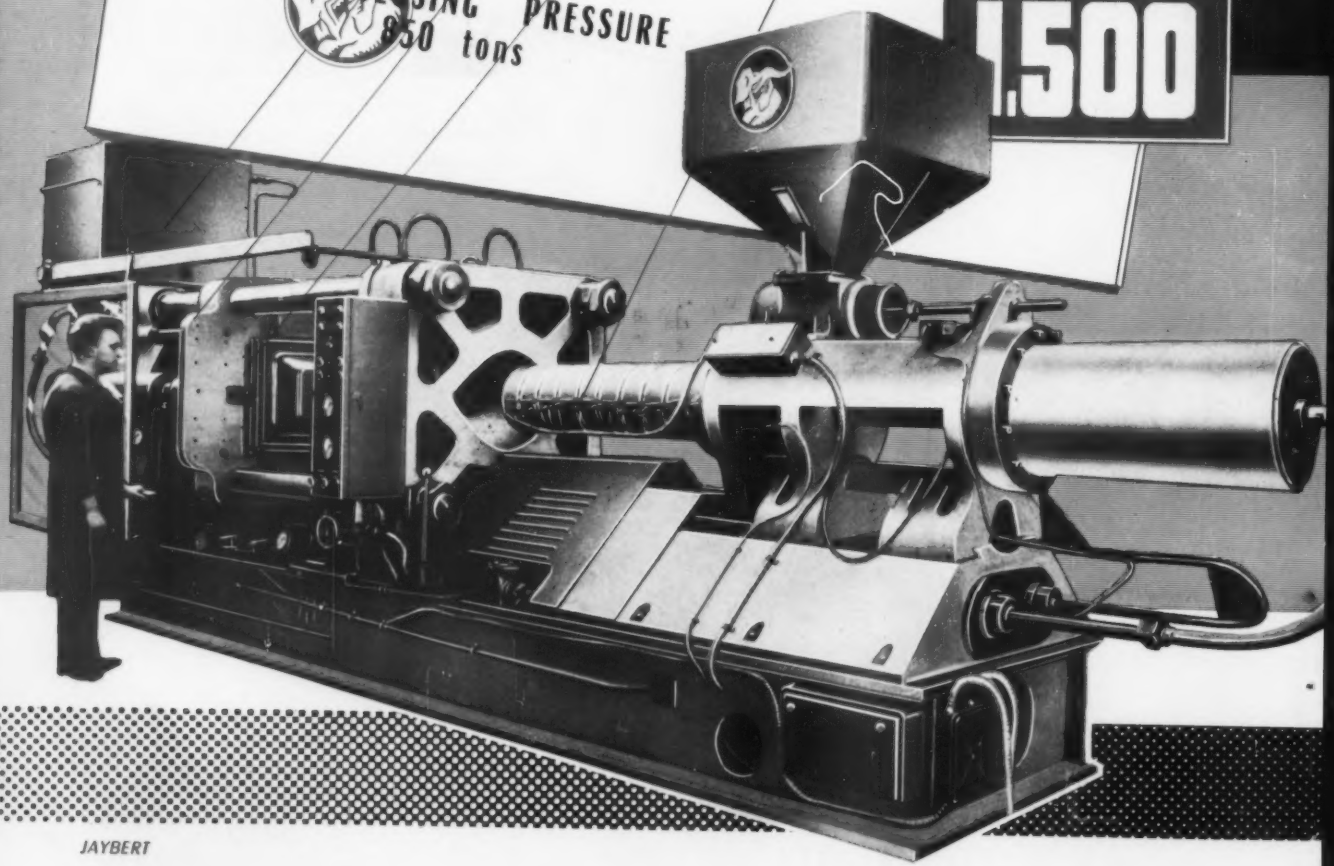

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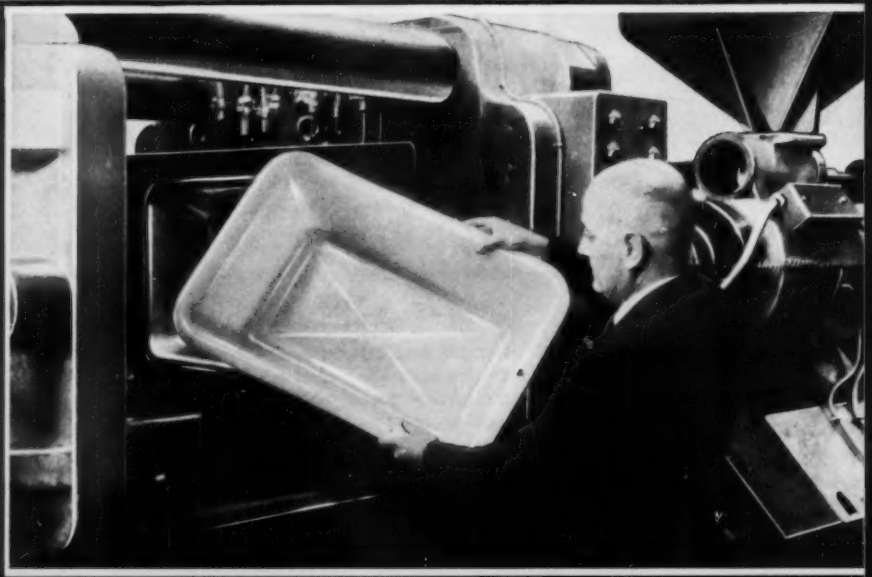

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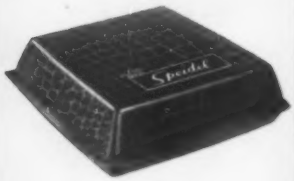
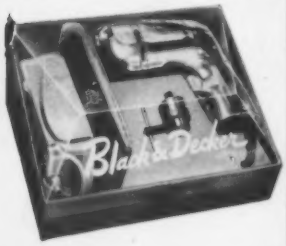
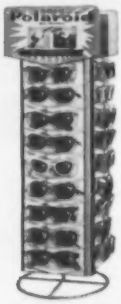


NIXON MODIFIED VINYL
for a luxury look. Rich brown alligator grain is meticulously reproduced in this attractive display case for men's jewelry. Nixon supplies all types of vinyl sheeting with exceptionally fine forming characteristics, up to 54" wide, in gauges from .005 to .040. *Pressure formed and constructed by Plaxall Inc., Long Island City, N. Y.*



NIXON CELLULOSE ACETATE
creates a sparkling, sales-appealing gift package for quality power tools. Provides visibility as well as protection. The durable .020-gauge Nixon sheet was *vacuum formed by Klear-Form Pak, Inc., Baltimore 30, Md.*



NIXON HIGH-IMPACT STYRENE
for sturdy, lightweight rotary counter display and sales dispenser. *Designed and vacuum formed by Mechtronics Corp., Mamaroneck, N. Y.*

NIXON CELLULOSE ACETATE, BUTYRATE AND NITRATE SHEETING, in a striking variety of colors and patterns, were used for the sunglass frames, *manufactured by American Optical Co., Chelsea, Mass.*

NIXON CELLULOSE ACETATE BUTYRATE
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Fits-All Ice Cream Freezer Lids with outer surface of Geon are manufactured by Arrow Rubber & Plastic Corp., East Paterson, New Jersey and sold by Davis Products Company, Mountain Lakes, N. J. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material.

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MODERN PLASTICS

Don't miss...

Revolution in materials handling is the result of industry's swing to plastics tote boxes and trays. Their light weight, corrosion resistance, nestability, and break-resistance bring savings wherever they are used. Today many plastics tote boxes are formed to fit assembly-line components. See "Why plastics tote boxes," p. 106.

How well will that sheet form? An exciting new test measures the stretchability of thermoformable sheet over the whole operating temperature range. This means hours saved and dollars in the pockets of vacuum and drape formers and plastics products designers. See "New test of sheet formability," p. 145.

The extruder as a money-maker is discussed in the first of a series of articles. Today's plastics extruder embodies new developments which, along with the proper accessories and take-off equipment, enable it to do prodigious feats of processing. For the story of these developments read "The economics of plastics extrusion," p. 99.

A lesson in protection is to be learned from the shroud developed by Army Ordnance for the Corporal Missile. Made of nylon fabric coated with vinyl, this zippered weather-cover has a total of seven plastics in its construction. It has worked so well that makers of other delicate devices can adopt its engineering principles to their purposes. See "Raincoat for the Corporal," p. 116.

How big is the auto trim business? Taking all phases of the business into consideration, probably close to half-a-billion dollars a year and involving the use of plastics by thousands of trim shops. Here are the materials used. Here is how and why they are used. Read "Auto trim—big market for plastics," p. 112.

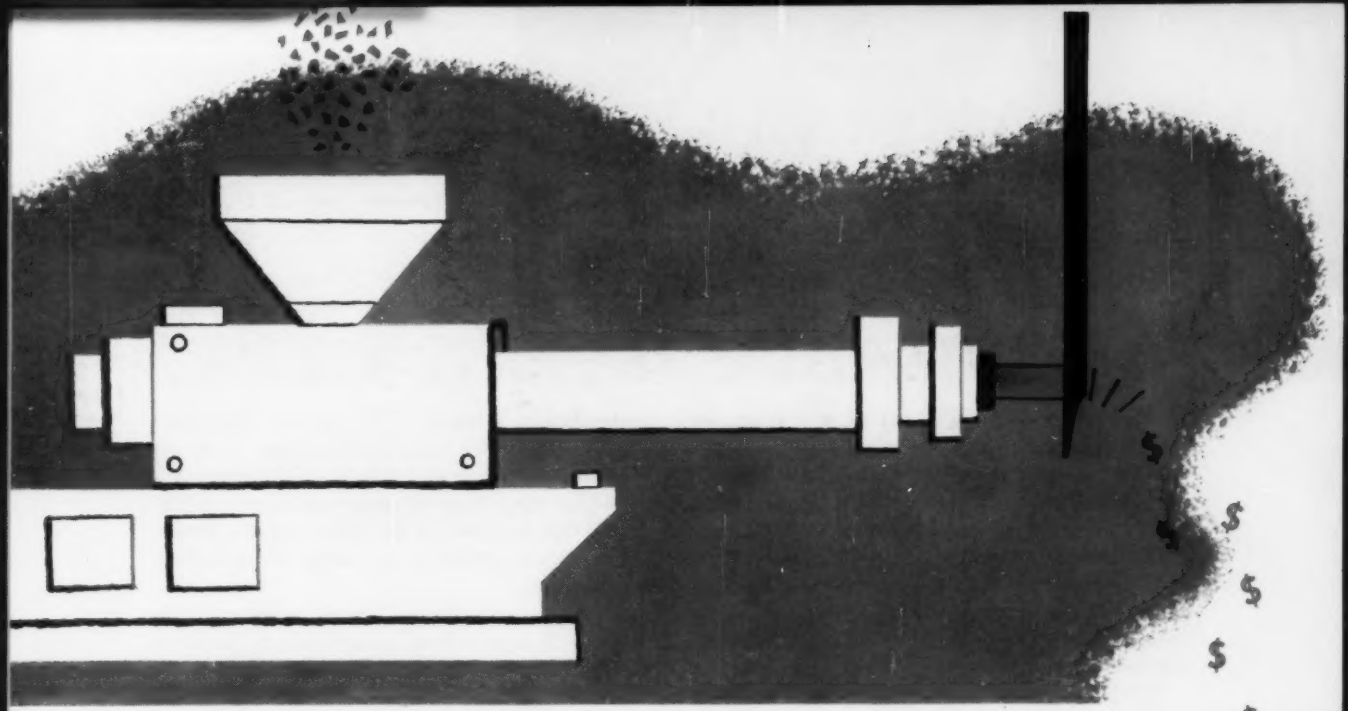
Save money with plastics tools. General Electric saved an average of 20% in time and cost on tools for jet engine parts by using forming dies, draw dies, and drill fixtures made from epoxy resin and glass cloth. See "Low-cost complex tools," p. 120.

Mass production of decorative concrete is made possible by thermoformed ABS sheet used as form liners. Glossy smooth, colored precast concrete building facings result. Each form liner may be used many times and the cost of replacement is low. See "Reusable plastics molds for concrete," p. 126.

Do-it-yourself premix of phenolic has definite economy in certain high-impact applications. Here is how it is done, and here are the economics spelled out. See "Premix your own phenolics," p. 135.

A lower-cost, dentproof world globe is changing methods of geography teaching. Kids can pass it around in class, but, since it is made of styrene alloy, can't break it. Using plastics, the maker was able to eliminate some manufacturing operations. See "Globes that can take it," p. 102.

Watch for... a complete presentation of new developments in plastisol formulation, processing techniques, and applications ... an analysis of the growing plastics tarpaulin field ... the continuation of our series of articles on the economics of extrusion ... surprises in our January annual review and outlook issues ... the full story on plastics boats, showing the various methods used in their manufacture.



The economics of plastics extrusion

According to a man who has spent 20 years in plastics extrusion, as an engineer, as the head of a custom and proprietary extruding company, and as a manufacturer of extrusion equipment, there is no machine in today's market, with the exception of the diamond grinder's wheel, that has as high an hourly return per dollar of invested capital as a plastics extruder!

This bold statement will naturally be subject to argument from makers and users of injection molding equipment and calenders—and even from extruders. But it is a fact that the number of pounds of thermoplastics going through extruders over the past few years has been increasing faster than the amount of materials processed by other methods.

Dry extrusion (without solvent) of thermoplastics is 20 years old this year, the first machine having been installed by Detroit Macoid Corp. in 1937. By 1939, three extruders were reported to be in use in the United States: 850 were reported in 1945; 1327 in 1947; 2307 in 1950; and 6069 in 1956.

Not only has the pace of extruder installation been furious, but the trend has been to bigger machines, primarily because pounds per hour of acceptable extrudate is the key to return on invested capital. There are quite a few machines now in use that can process upwards of 2500 lb./hr. and one is in operation now, compounding at a rate of 6000 lb. per hour.

Specialization in machines

In addition to their growth in size, extruders have also become more and more specialized. Between 1950 and 1953, the 1.7-in. to 3.2-in. machines were favorites. They were fairly standard, enormously versatile (if the plant had a good setup man), and could be used by custom extruders for high mark-up short runs. But as the swing to larger sizes began, the "standard" machines lost their competitive edge to the point where today almost every extruder from 3.2-in. up to every 15-in. is built for a single purpose. Frequently, they are intended for use with a narrow range of materials and sometimes for only one material. These new machines are used to squirt out film, pipe, and sheet at rates unheard of even five years ago, as well as to compound.

As bigger, single-purpose extruders came into use, several significant changes were made

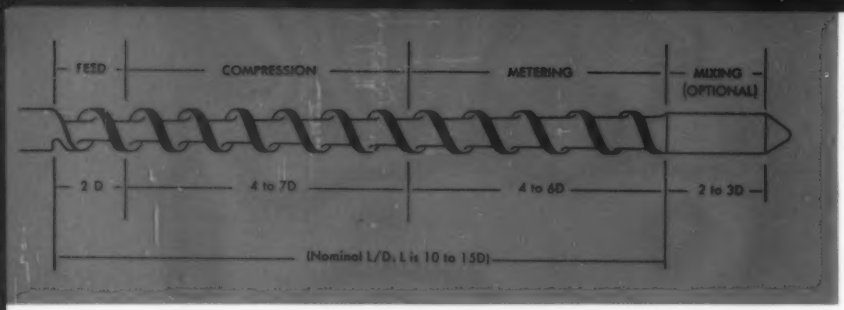


Fig. 1: Typical extruder screw. Nominal L/D ratio indicated in drawing is standard specification used in purchasing extruder. (Drawing, Monsanto Chemical Co.)

in extruder design. The art of extrusion, by virtue of these changes, is rapidly turning into a science—with profit ratios much more predictable. From the mechanic who finished a die by tapping it with a ball-peen hammer, the bright young scientists with their slide rules took over, with a view to finding out what went on inside the machine. Their findings have already resulted in a number of significant advances.

First, balanced heat control was effected, along with centrifugally blown air cooling, to avoid hot spots. This made electrical heating safer, prevented degradation of material in the extruder barrel, and minimized scrap.

Second, control instruments were adopted and instrumentation linked to the condition of the material being worked. This meant that adjustments could be made in seconds, paving the way to automation.

Third, machines became longer. It was found that longer screws increased output, reduced fluctuations in output rates, and gave the material a better treatment in terms of heat and compression. This is how the now-standard "L/D ratio" came into the language of extrusion. It is the threaded length of the screw divided by its outside diameter, as shown in Fig. 1, and the diameter of the outside of the screw. Today this is a specification term in purchasing an extruder.

Fourth, screw design became more of a science, with screws now being made to handle a particular material most efficiently and/or to do certain specific work, such as extruding rigid sheet for thermoforming. Five typical screw designs are shown in Fig. 2.

Fifth, venting of the barrel to allow volatiles to escape brought more economical use of heat, since no pre-drying is needed. Some polemics exist as to the proper location of the vent in the barrel, but the trend is towards more, not fewer, vented machines.

Sixth, adiabatic extrusion was made practical, wherein higher screw speeds are used to take advantage of frictional heat. Although few high-speed extruders are being used in this country, they are sure to gain wider acceptance.

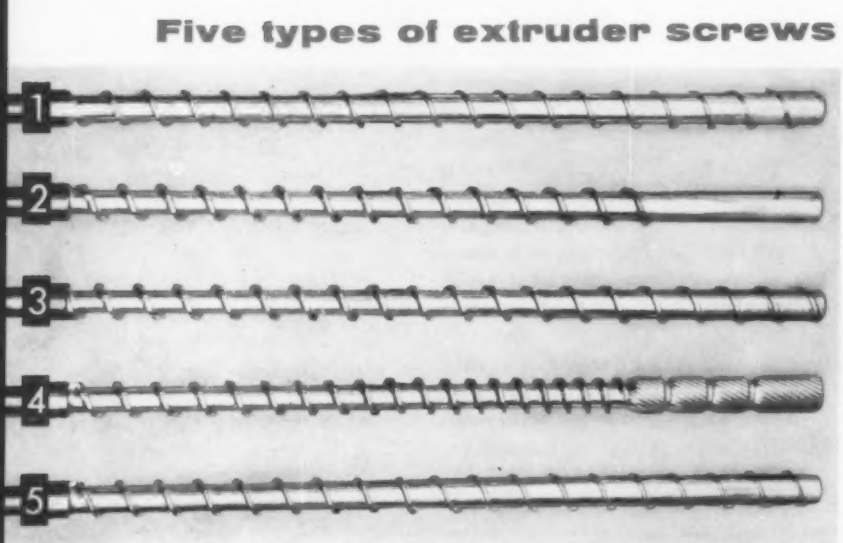
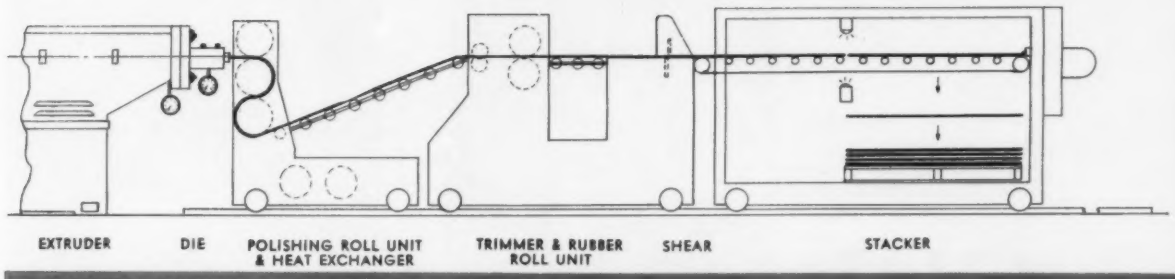
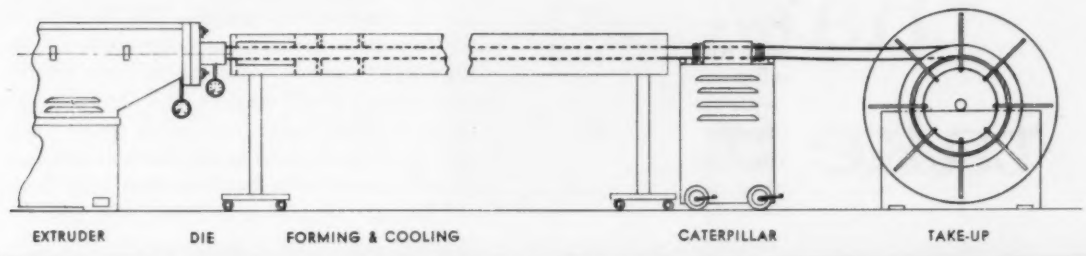


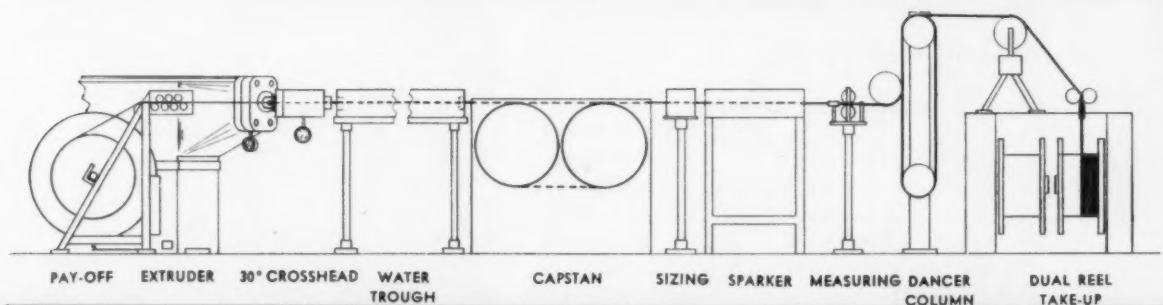
Fig. 2: Various screw designs: 1) Shallow-, single-, full-flighted; compression ratio, approx. 4:1; generally recommended for elastomeric vinyl powdered dry blends. 2) Single-flighted, with smooth torpedo; comp. ratio, 2:1; generally recommended for acetate, butyrate, ethyl cellulose, and styrene. 3) Deep-, single-, full-flighted; comp. ratio, approx. 2:1; generally recommended for rigid and elastomeric PVC compounds in pellet form. 4) Single-flighted, with Dulmage (patented by Dow) torpedo; comp. ratio, approx. 2:1; mainly recommended for impact styrene, but occasionally used for other plastics when extreme mixing or working is required. 5) Single-, full-flighted, polyethylene type with metering-type torpedo; comp. ratio, approx. 4:1. (Photo, National Rubber Machinery Co.)



SHEET EXTRUSION INSTALLATION



PIPE EXTRUSION INSTALLATION



WIRE COATING INSTALLATION

Fig. 3: Three different types of take-off plants for three different types of extrusion installations. The profit the extruder will pay is said to depend strongly on the effectiveness of the take-off equipment. (Drawings, courtesy Prodex Corp.)

(see p. 200, this issue, for a description of a line of heaterless extruders).

Seventh, science has been applied to die design. While this function is still in its infancy, it is possible today to design dies that make the desired shape economically and reliably. Knowing the die dimensions, flow properties of the material, and the type and dimensions of the screw, extruder performance can be predicted.

Eight is the revolution in take-off equipment which started very recently and which is still going on. If you want to make film, pipe, rigid sheet, tubing, or coat wire or paper, it is necessary to use properly designed and engineered take-off equipment for the product and often the material being run. Three typical take-off plants are sketched in Fig. 3.

And here is the payoff on economics: the better designed and the better tuned the take-off equipment, the more profit the extruder itself will pay. In general, it is wise to allocate as much money for take-off equipment as for the extruder itself.

With all these advances, is it any wonder that the economics of extrusion look so favorable today? Experts point out that one reason some extrusion equipment is not making as much money as it should is because its operation is being directed, not by competent engineers, but by "truck drivers and (*To page* 234)

Globes that can take it

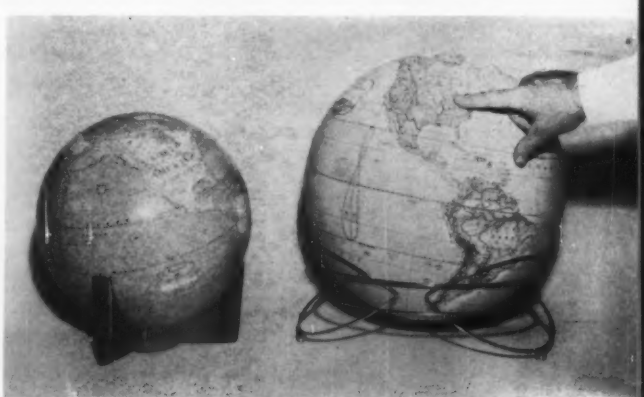
Pass-around globes for school-room use are molded of high-impact styrene for light weight and strength

It's a tough world—so tough it can even be bounced on a concrete floor without damage!

The reference, of course, is to the educational world globes produced by Rand McNally & Co., Chicago, Ill., for use in schools. This company uses injection molded high-impact styrene shells for its 12-in.-diameter globes; compression molded 16-in. globe shells, also of high-impact styrene, are being converted to injection molding for faster production.

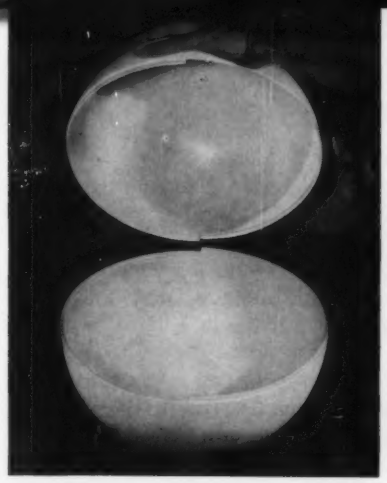
Much lighter in weight than the sheet steel units formerly used, the plastic spheres also eliminate several time-consuming manufacturing operations required with their metal counterparts. Furthermore—unlike the metal shells—they will not dent if accidentally dropped or bumped against a hard object, such as a desk.

In this age of global military and political



High-impact styrene inner shells impart durability and light weight to these 12- and 16-in. educational world globes. Globe at left has injection molded butyrate cradle from which it may be easily lifted for closer examination and study

Lightweight, durable globes made from high-impact styrene are helping youngsters in schools throughout the country toward a better understanding of the earth. Damage resistant and easy to handle in the classroom, this plastic teaching aid is finding growing acceptance in educational circles. (Photo, Catalin Corp.)



Globe halves prior to assembly. Tongue-and-groove edges permit identical parts produced from single-cavity mold to be securely solvent-cemented together at equator line. Internal lugs help hold assembled rim in permanent alignment. Total weight of 12-in. shell is approximately 29 ounces

Although not recommended as standard practice, styrene globes can be bounced off concrete floors without damage. Unlike metal shells used previously, plastic shells do not dent under such impacts

concepts, schools are placing increased emphasis on world globes as educational tools. A well-designed globe not only shows students the location of oceans, continents, mountain ranges, cities, etc., but also graphically illustrates the rotation of the earth, what causes night and day, changes of the seasons, and other physical phenomena. In years past, most school globes were rigidly mounted on a fixed axis and just as rigidly protected against handling by the individual student. By contrast, many modern globes rest in a cradle from which they may be lifted and passed among the students for closer scrutiny. This enlightened teaching technique demands globes that are light in weight, easy to clean, and highly resistant to breakage.

Rand McNally's miniature worlds have undergone several manufacturing changes through the years. Until a decade or so ago, the globes contained a stiff paperboard inner shell over which a ⅛-in.-thick layer of plaster of paris was cast. Relatively fragile and heavy, the plaster-shell globes had to be carefully guarded against damage. Even with the later addition of a burlap cloth reinforcement for the plaster shell, these globes left much to be desired in durability.

Next came the introduction of formed sheet steel shells, made in two halves joined by welding. The metal shells were relatively heavy, weighing approximately 3 lb. for a 12-in. globe. They also required a hot solvent degreasing operation at the Rand McNally plant to remove grease picked up from the draw dies. This was followed by spraying with a rust-preventative so that the water-soluble paste used in mounting the printed map sections to the core would not erode the metal shell. These operations were costly and time-consuming.

Plastics investigated

Several years ago, Rand McNally began investigating injection molded thermoplastic globe shells, made in two mating halves solvent-cemented together. Both cellulose acetate and cellulose acetate butyrate were tested for this purpose. These shells proved adequately strong, but some difficulty was experienced in getting the paper gores to adhere satisfactorily to the plastics surface. One problem was the contraction and expansion of the plastics shells, which sometimes caused loosening of the paper map segments or slight edge separation of adjacent gores. Continued experimentation with thermoplastics led to the adoption of high-impact styrene.

Hemispheres for the 12-in. globe shells are produced in a single-cavity mold running on a 22-oz. injection machine. The part is center-gated and the gate is milled off by the molder. The edge of the hemisphere is made with a half tongue-and-groove construction, so that two identical units can be telescoped together to form a completed sphere having a smooth joint along the equator line.

In the past, shells for the 16-in. globes have been produced in two halves in a single-cavity mold run in a compression press. Interchangeable die inserts were used to obtain mating male and female rims on the plastics part. The

Shells are rotated in fixture to make pencil line along equator as guide for accurate mounting of paper map gores

Latex-impregnated paper on which map is printed can be stretched to conform smoothly to contour of globe. Operator is shown using rounded bone tool to mount map sections accurately on plastic shell

Finished globe is rotated and sprayed with coating of clear lacquer, providing washable surface that can also be marked with erasable crayons for class instructions

molding technique involved extruding a slug of impact styrene material and placing it in the compression-type mold to shape the finished hemisphere. This larger shell is now being retooled for injection molding and the 16-in. hemispheres will be made in a 48-oz. injection machine.

Before the map-mounting operation, each plastics shell is rotated in a fixture, and a pencil guide line applied for locating the paper gores. A conventional water-soluble wheat paste is applied to the 12 die-cut gores and the latter are stacked, distributing the paste on both sides of the strips and providing a slick surface which facilitates sliding them into accurate position on the shell. The paper on which the map gores are offset printed is a specially developed latex resin-impregnated stock combining extreme durability, water and chemical resistance, high initial tear strength, and brilliant color reproduction. When wetted with the adhesive, the paper becomes extensible, enabling the mounter to accomplish the seemingly impossible task of applying a flat piece of paper smoothly to a curved surface.

Skilled mounters at Rand McNally apply various types of maps to the plastic shells at rates as high as 20 globes per day. After the mounting operation, excess paste is removed from the surface of the globe and another operator checks for minor imperfections, applying touch-up colors if necessary. The finished globe is then rotated and sprayed with a coating of clear lacquer, giving it a washable surface which accepts erasable map-marking crayons.

Among the several types of optional bases available with the Rand McNally globes is a one-piece, injection molded base of transparent blue cellulose acetate butyrate. Like the globes themselves, this attractively designed base, from which the globe may be conveniently removed for closer examination, is sufficiently sturdy to withstand shipment, dropping, and other impacts without damage. Both the globe and the base—thanks to selected plastics—are built for years of trouble-free use.

Credits: Twelve-inch globe shells molded by Continental Can Co., Inc., Millsplastic Div., Chicago, Ill., using Catalin high-impact styrene. Sixteen-inch globe shells molded by The Richardson Co., Melrose Park, Ill. Texoprint resin-impregnated paper for globe maps, Kimberly-Clark Corp., Neenah, Wis. Molded butyrate base, Chicago Molded Products Corp., Chicago, Ill., using Eastman cellulose acetate butyrate.

Credit cards in plastics

Millions of "charge" customers are now carrying in their billfolds and pocketbooks colorful, durable credit identification cards which because of their many points of superiority are rapidly replacing metal credit plates. Fabricated by printing, laminating, embossing, and die-cutting rigid vinyl sheet material, the new plastic identification cards are lighter in weight than their metal counterparts, thinner, more flexible, more durable, more convenient to carry and use, and can be printed in a combination of colors for merchandising appeal. The tops of the embossed characters are color-tipped with a plastic dye to increase legibility and permit use of the card as a self-mailing device.

Addressograph-Multigraph Corp., Cleveland, a major supplier of credit identification plates for more than ten years, developed self-writing anodized aluminum plates in 1953. These plates, which offered accuracy, legibility, and speed in making credit purchases, also served as an extra advertising medium, carrying the name and sales message of the issuing store or other organization. In 1955, Addressograph-Multigraph introduced the plastic credit card, which was quickly adopted by a number of major oil companies and other business organizations. These "billfold billboards," as Addressograph calls them, combine all the economic advantages of the old-fashioned paper credit card with the functional advantages of self-writing Addressograph plates.

Printing on the plastic credit cards is protected against abrasion by a layer of transparent vinyl sheeting laminated to both sides of the card. A specially processed area is provided which accepts ink and is used by the credit customer to sign his name. Any attempts to erase the signature automatically voids the card.

The cards are made to fit special imprinters which transfer the name, address, and account number of the user directly to sales slips. Portable imprinters can be fastened to counters inside service stations, department stores, banks, etc.

Another type of imprinter widely used by service stations is combined with a pump island credit office box. Handily mounted next to the gas pump, it permits the (*To page* 237)

Among users of the new and more convenient plastic charge plates are major oil companies, department stores, banks, and hospitals. A specially processed area permits customer to sign name on card in ink. A bonus feature is that plates can be supplied in any desired combination of colors. (Photos, Bakelite Co.)

Reinforced plastics tote box, with form-fitting liner, is used to carry chocolate-covered candy. Smooth surfaces and long service life make such industrial tote boxes ideal for food handling. (Photo, Molded Fiber Glass Tray Co.)

Why plastics tote boxes?

For a little more money the user gets longer life, lighter weight, corrosion resistance, real product protection, and custom dimensioning

Plastics tote boxes have already become almost indispensable in many fields, despite the fact that they are competing with materials as old as the industrial revolution itself. Although plastics tote boxes have been in use less than ten years, they do such big and varied jobs in industry today that it's hard to imagine how the world of commerce ever got along without them. They are being used to handle virtually everything from pharmaceuticals to pickles.

No other material, in itself, has all the advantages for tote boxes that plastics offer by their very nature. Plastics boxes are extremely light, stackable, nestable, virtually unbreakable (unlike wood), corrosion-resistant (unlike metal), and they can be molded to the exact contours of a specific part or product (unlike anything else).

Boxes formed of thermoplastic sheet have a soft, somewhat resilient surface which will not damage precision parts, and are made with low-cost tooling, which makes short production runs

Sources of industrial tote boxes

economical. As a finishing touch: transparency, where desired, can be had in plastics tote boxes.

With all these virtues, it's natural for plastics tote boxes and trays to do a broad and infinitely varied job in materials handling. Actually, the phrase "tote box," meaning a simple container of regular dimensions used to hold and carry unassorted objects, accurately describes only a small percentage of the plastics handling containers in use today.

Products always visible

A great number of the boxes used in industry are contoured around a specific part. This contouring makes it possible to hold products or sub-assemblies securely and safely, without wrapping, and completely visible at all times. Without such a container, parts often must be wrapped for protection; and all along the production line they must be wrapped and unwrapped for inspection and other reasons. This is the general method in use among the unenlightened. It wastes time, may be rough on the part, and often results in lost parts. With a contoured container, protective wrapping isn't necessary. Every part of a complex assembly has its place, and a missing or damaged piece can be detected at a glance.

This need for full visibility of parts moving through a plant is considered to be the greatest single appeal of the formed plastics tote box by Art Harris, president of Product Engineering Laboratories Co., Inc., Orange, N.J. This company operates as a materials' handling engineering firm, and is a plastics forming house only in connection with its service to industry.

The question of cost

Naturally, the commercial importance of plastics tote boxes is related to their cost in comparison with other materials—metal, wood, and paperboard. As is to be expected, the original cost of the plastics boxes is usually higher than for those made of any of the other materials. But the long-range economics work in favor of plastics. It is estimated that the average clean and useful life of a wooden tote box is three months, and metal five years. The life of a plastics box is virtually unlimited—it is reported that the first boxes ever manufactured are still in use. And with plastics, there are no maintenance costs: plastics do not have to be periodically repainted, renailed, or straightened.

Long-range economics also work for plastics in another way: Other materials are going up in price while plastics, due to competition among materials suppliers and improved forming methods developed by fabricators, are coming down. In many cases, even now, plastics tote boxes are underselling wood. An impressive example is a box formed by Product Engineering for a producer of precision parts. The thermoplastic box, holding 50 small parts, replaced a wooden box that held only 24, at a saving of $3 a unit, for the plastic box and insert. (See pictures, p. 109.) All the plus values

Formed to fit the part

Thermoplastic box (left), contoured to hold telephone relays, offers better protection, is more easily cleaned, and requires less dead space in storage than wooden box it replaces. Locking-lid box (above) with one of 300 standard inserts offered by manufacturer, has clear, hingeless acetate cover which slides into place. (Photos, Product Engineering)

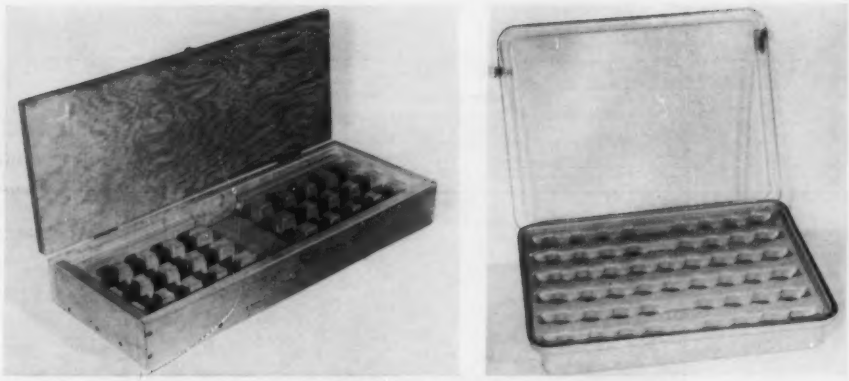
Telephone dial tray used by Western Electric replaces corrugated-board box with paper egg-crate insert. The thermoplastic box solved problem of paper chips or dust entering assemblies, is kinder to workers' hands. (Photo, Regal Plastic Co.)

Sources of industrial tote boxes

Tote box manufacturer	Tradename	Materials	Production methods	Sizes (in.) and types
Baxter Co. 2060 Reading Rd. Cincinnati 2, Ohio	—	Thermoplastics	Thermoforming	Custom only*
Blackman Plastics Inc. 5883 Blackwelder St. Culver City, Calif.	Blackman	ABS, styrene, vinyl, acrylic, butyrate	Thermoforming	Complete line; sizes range from 12½ x 8½ x 3 to 33½ x 22½ x 10*
Charles Crowl Co. 11667 McBean Drive El Monte, Calif.	Fireban	Crowl F-200—alloy of vinyl and styrene	Thermoforming	Bus boxes only in 2 sizes 22 x 13 x 6, and 20 x 16½ x 5
Chicago Molded Plastics Corp., Cloverlane Dinnerware Div. 1020 N. Kolmar Ave. Chicago 51, Ill.	Mess-Haul	Campco copolymer styrene	Thermoforming	Bus boxes only in 2 sizes 20 x 15 x 5, and 18 x 14 x 5
Durable Formed Products, Inc. 6 Greene St. New York 13, N.Y.	Durable Systemtotes	ABS, styrene, acrylic, butyrate, other thermoplastics	Thermoforming	Complete line; sizes range from 12 x 8 x 3 to 24 x 15 x 12*
General Plastics Corp. 2260 Centinela Ave. Los Angeles 64, Calif.	—	ABS, impact styrene, other thermoplastics	Thermoforming	Complete line; sizes range from 10 x 6 x 3 to 30 x 20 x 15. Dividers can be changed to vary compartments*
Gregstrom Corp. 14 Davis St. Cambridge, Mass.	Gregstrom Tote Box	ABS, impact styrene, polyethylene, butyrate, others	Thermoforming	Complete line of sizes from 11 x 7 x 2 to 40 x 18 x 12. Partitions optional*
Hollywood Plastic Arts, Inc. 513-15 E. Ninth St. Los Angeles 15, Calif.	Modubox-Duro Tote Tray	ABS, other thermoplastics	Thermoforming	Complete line & size range; 75 different items*
Kingston Products Corp. 1412 N. Webster St. Kokomo, Ind.	—	ABS, impact styrene, polyethylene, styrene terpolymer	Thermoforming	Full line of open trays from 10 x 9 x 3 to 34 x 31 x 10
G. B. Lewis Co. Watertown, Wis.	Plexton	Polyester resin & glass fibers	Matched Metal Molds	Five basic models. Full range of sizes, from 14 x 11 x 4 to 46 x 20 x 5¼. Other depths to 11
Mercury Plastics Corp. 7 Springfield St. Chicopee, Mass.	—	ABS, vinyl, butryrate	Thermoforming	Trays, ranging from 8 x 5⅜ x 4 to 15¾ x 9¾ x 4*
Molded Fiber Glass Tray Co. E. Erie St. Linesville, Pa.	Toteline	Polyester resin & glass fibers	Matched Metal Molds	Complete line; 70 different products, ranging from 11 x 8 x 4 to 21 x 18 x 10. Flat trays 3 x 6 ft.
Product Engineering Laboratories Co., Inc. 555 Central Ave. Orange, N.J.	Pelco	ABS, impact styrene, vinyl, butyrate, acetate, acrylic, others	Thermoforming	Complete line of 700 standard items; sizes range from 8 x 6 x 2 to 24 x 12 x 12. Engineering services on materials handling*
Regal Plastic Co. 2800 E. 14th St. Kansas City, Mo.	—	ABS, other thermoplastics	Thermoforming	Custom only*
U.S. Rubber Co. 2638 N. Pulaski Rd. Chicago 39, Ill.	U.S. Royalite	Royalite (ABS)	Thermoforming	Full line of open, uncontoured boxes, ranging from 12½ x 9½ x 3 to 27 x 21 x 14

*Inserts and covers to order.

Better boxes, $3 less



Wooden box (left) designed to carry 24 precision parts, has been replaced by thermoplastic tote box (right) that can cradle 50 of the same units and costs $3 less (including both box and insert). Insert can be discarded at end of job and box used for other purposes. (Photo, Product Engineering)

of a transparent cover, better locking arrangement, soft, smooth feel, and indefinite longevity were thrown in free.

The way plastics boxes nest and stack is a big part of their allure. In nesting, empty boxes are telescoped into each other up to their rims, to conserve space when they are not in use. In stacking, full boxes can be piled upon each other to make a sturdy tier, allowing the most goods to be stored in the minimum space. Most manufacturers offer boxes that can be both nested and stacked.

Basic types

There are two basic types of plastics tote boxes. The first—those formed from thermoplastic sheet—is probably the most important commercially. The second type is the reinforced plastics tote box. These two types have different advantages and different economics, but they do compete in many areas. Generally, the thermoplastics tend to compete with wood or corrugated board, while reinforced plastics tend to compete with steel or aluminum. Boxes formed from thermoplastic sheet are unbeatable, cost-wise, in short production runs, since tooling costs are very low. Equipment is simple, and inexpensive wooden molds, tailored to fit specific customers' needs, are quite satisfactory. On the other hand, material costs per pound are relatively high.

Fibrous glass-reinforced polyester boxes lend themselves to long production runs because of the matched metal mold production system used, which yields a finished tote box. On small-run orders, it does not pay to use fibrous glass because of the cost of the durable molds, or the alternative hand lay-up method, which is expensive.

For this reason, Molded Fiber Glass Tray Co., Linesville, Ohio, the biggest firm in the field, seldom accepts orders for less than 500 units. But the company has been able to undersell thermoplastic competition by as much as $1 a unit on a mass production "bus" box used as a clean-up tray in restaurants and other institutions. This product is only one of 70 offered by the company.

Bus boxes are a substantial-volume young specialty for plastics; both raw material suppliers and manufacturers are excited about the potential. Several firms have recently entered the field—notably Chicago Molded Products

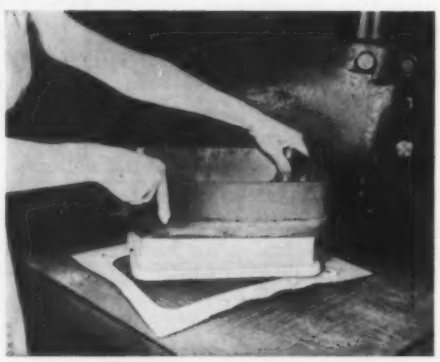
Built-in glamour

Restaurant clean-up tray, made by Charles Crowl Co., combines utility with beauty of walnut woodgrain exterior. (Photo, Goodyear)

Forming

Thermoplastic tote boxes and trays are formed on simple equipment and molds

Trimming



Where practical, a clicker die is used to trim flash, as for this Pelco box. Clicker is also used subsequently to blank out lids for the box

Finishing

After flash is removed, edges are finished on buffing wheel. (Photos, Product Engineering)

Corp., Chicago, Ill., with a styrene copolymer entry, and Charles Crowl Co., El Monte, Calif., with "walnut woodgrain" and "charcoal linen" bus boxes formed of vinyl-styrene alloy sheet.

Acrylonitrile-butyadiene-styrene

The most important material for thermoplastic tote boxes appears to be acrylonitrile-butadiene-styrene polymer blend (lately dubbed ABS plastic), supplied mainly from two sources: U. S. Rubber Corp., Chicago, Ill., which sells Royalite, and Bolta Products Inc., Div. of General Tire and Rubber Co., Lawrence, Mass., which offers Boltaron. Both firms have been very important in the development of the thermoplastic tote box, with salesmen out beating the bushes for new applications, backed up by research and development men in the laboratories. U. S. Rubber itself is an important supplier of tote boxes, offering an extensive proprietary line of uncontoured, open boxes.

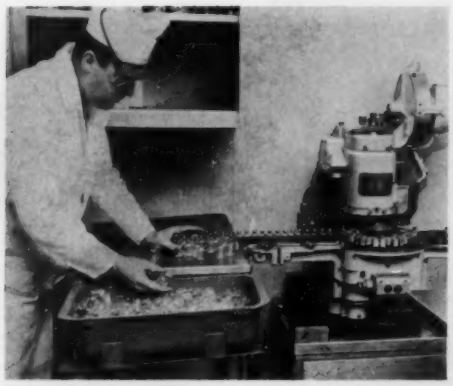
ABS plastic is a good, all-around material for tote boxes, with ample impact strength, ease of draw, high chemical resistance, and immediate availability in unlimited quantities. This last factor is important.

High-impact styrene sheet—in particular Styron 480, supplied by The Dow Chemical Co., Midland, Mich.—is a good tote box material except for its tendency to break down when in contact with oil. It represents a substantial cost saving over ABS, and should enjoy a sound market when it comes into more general use.

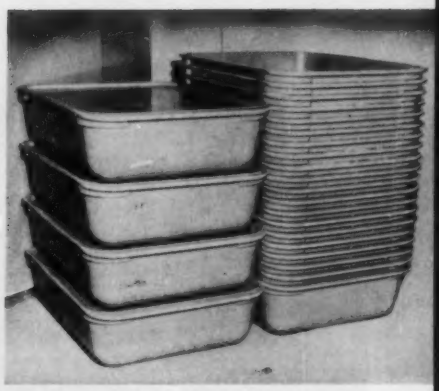
Chicago Molded Products, as a materials supplier, offers three types of thermoplastic sheet. Rubber-modified styrene, the lowest-priced material, forms easily, according to the company, but does not have the tensile or flexural strength of polyethylene or styrene copolymer. Polyethylene, next in cost, does not form as readily. The Campco styrene copolymer sheet, at the top of the price list, combines the advantages of the other two.

Polyethylene has long been an attractive material for tote boxes, and has found some use, but it is difficult to form and generally requires special equipment and tools. The new linear (high-density) variety of polyethylene looks better, but is proportionately harder to form. On this subject, Louis DiDonato, general manager of Gregstrom Corp., Cambridge, Mass., supplier of a full range of tote boxes, says: "In the near future more of the polyethylenes will be used as better forming techniques are de-

Designed for the job



Vials and ampules of biological products can be handled efficiently and without trouble by Sharpe & Dohme with reinforced plastics tote boxes especially engineered for this application



Full or empty, plastic tote boxes take up a minimum of space; when full, they can be stacked (left), when empty, they can be nested (right). (Photos, Molded Fiber Glass Tray Co.)

veloped by the fabricators. I might add that a lot more development work can be done by polyethylene suppliers and sheet extruders to help the fabricator."

In addition to the materials above, Cycolac, a styrene terpolymer similar to ABS (Marbon Chemical Div., Borg-Warner Corp., Gary, Ind.), and Pliovic, a vinyl chloride polymer (Goodyear Tire and Rubber Co., Akron, Ohio) are offered to tote box manufacturers.

Transparent covers are made from four plastics: acrylic, acetate, butyrate, and clear PVC.

Shape of competition

The materials competition in thermoplastic tote boxes shapes up something like this: ABS, the standard of the field, is now being challenged by the much lower-priced high-impact styrene, which, however, does not have the proved wearing qualities and impact strength of ABS. In many cases the superior impact strength is not needed, but customers have a habit of asking fabricators for the "best impact strength we can get."

In the words of J. S. Kivett, vice president of Regal Plastic Co., Kansas City, Mo., "once we have available a material in the 50 to 55¢/lb. bracket for an extruded sheet, such as high-impact Styron, but in a material more comparable to Royalite (around $1/lb.), this field would really break wide (*To page* 239)

Inspection line tray

Lightweight all-purpose reinforced plastics trays, used here during inspection operation, have satin-smooth finish to protect assemblies being inspected. (Photos, G. B. Lewis)

Designed for do-it-yourself installation, one-piece, three-dimensional quilted door panel can be bonded, stapled, or tacked directly to automobile door frame or over old upholstery. (Photos, Jason Corp.)

Flight-Backs prefabricated decorative panels made with heavy vinyl face and reinforced with knit cloth, enable trim shops to turn out highly styled seat covers without time-consuming cutting and pattern work. Built-in piping insures a smoothly finished edge after sewing

AUTO TRIM-

Acres of woven saran monofilaments and vinyl-coated fabrics, millions of square feet of press-polished heavy-gage clear vinyl sheeting, and uncounted miles of stitched and extruded piping, welting, and related items tell the growing success story of plastics in the replacement auto trim field. With Americans increasingly aware that good car-keeping also includes the interior of the family automobile, selected plastics are gaining important new volume in seat covers and interior trim, replacement tops for convertibles, and convertible rear windows.

According to the Automobile Seat Cover Manufacturers' Association, the seat cover industry grossed about $250 million in 1956, representing sales of 12.5 million seat covers. This marked an increase of 10% over 1955 figures; a further 10% gain is expected for 1957.

Figures from ASCMA, made up of the leading seat cover manufacturers and their suppliers, indicate that seat covers of saran plastic represented about 33% of total unit sales in 1956. Fiber seat covers—many of which have a vinyl coating for improved durability and cleanability—accounted for another 30 percent. "Clear plastic" covers—heavy-gage transparent vinyl sheeting—made up around 20% of unit sales, and "Jetspun" (a solution-dyed rayon yarn fabric) another 12%, with the remaining 5% classed as miscellaneous.

Reasons why

Unlimited color and pattern selection, transparency where required, durability, resistance to weathering, staining, and soiling, and excellent cleanability are among the properties of plastics which appeal both to the trim shop operator and the seat cover buyer. In addition, the materials are convenient to cut, sew, and fabricate into finished products, and economical in terms of service life.

Despite the inroads of other materials, woven saran seat covers continue to be the standard for the industry. Notable for their durability, breathable properties and ease of cleaning, saran covers are made by a number of companies who purchase the woven fabric from basic suppliers. Saran covers usually retail at from $20 to $50 per set. Many such covers are trimmed with matching or harmonizing vinyl-

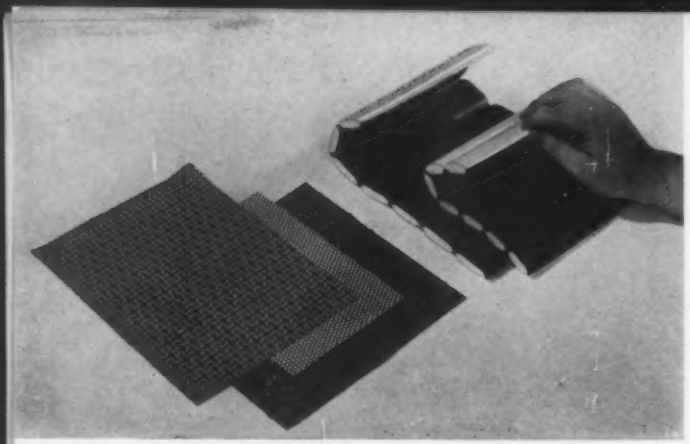
Extruded vinyl, stitched vinyl-coated fabrics, and metallized Mylar film are among materials used for gimp, welting, bias strips, etc., by auto trim shops. Some of the samples shown above contain cord or wire reinforcement. (Photo, Novelty Bias Binding Co.)

Long-wearing, easily cleaned Fry "Show-Off" seat covers have elastic straps and hooks to expedite their installation and, when necessary, their removal. (Photo, Firestone)

big market for plastics

A wide variety of calendered, extruded, woven, cast, coated, and laminated vinyl-family materials are fabricated by thousands of trim shops. $275 million in seat covers alone this year!

Heavy-gage vinyl sheeting is used in new transparent seat covers, now said to represent more than 25% of seat cover sales. Installed principally on new cars, they protect original upholstery against soiling or damage without concealing its handsome appearance. (Photo, Bakelite Co.)



Air-permeable vinyl fabrics (Naugahyde at left) and quilted vinyl incorporating vinyl foam (Bolta Foam-Quilt at right) are among newer materials available at auto trim shops

coated fabrics or quilted vinyl materials. Seams may be reinforced with vinyl or Mylar welting, as in other seat cover constructions.

An aid to comfort, too

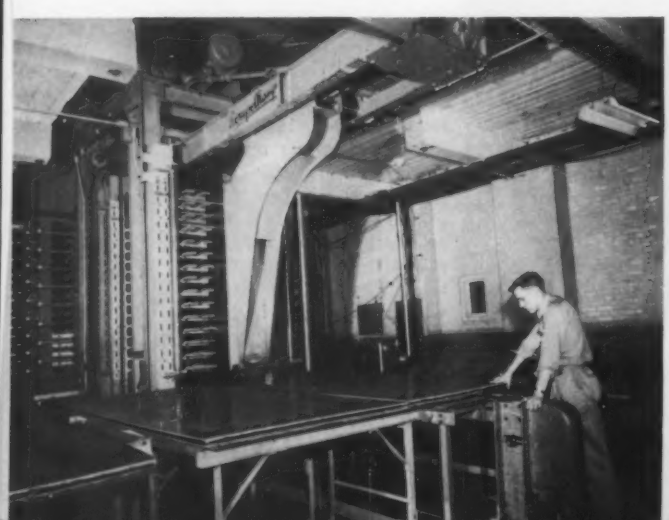
Three-dimensional saran fabrics are an interesting new material now available. One such material is Lum-Puf, latest development of the Lumite Div. of Chicopee Mills. This "puffed" saran upholstery material offers added seating comfort because, as the body moves, the three-dimensional surface permits circulation of air.

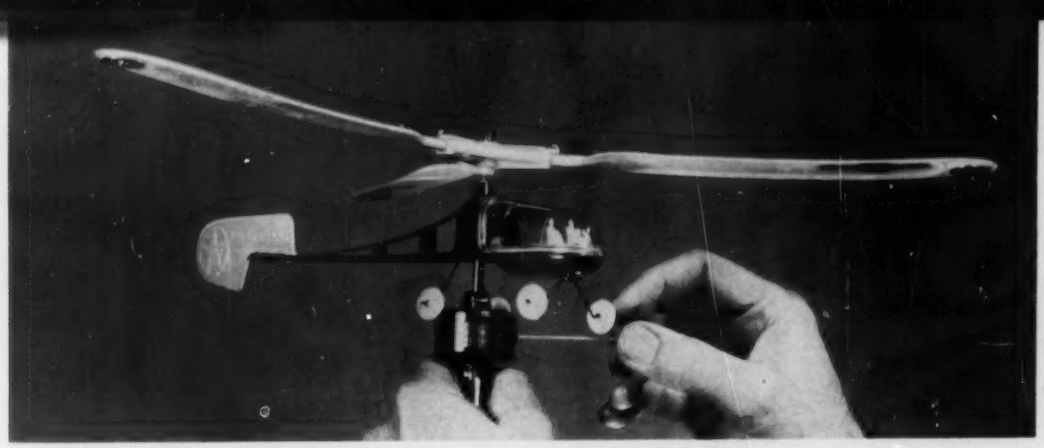
Another three-dimensional material coming into the auto trim field is Trilok, a product of the textile div., U. S. Rubber Co. In its manufacture, shrinkage, hitherto an undesirable feature of textiles, is used under controlled conditions to achieve new patterns and textures, along with depth. Woven flat on a regular loom with conventional fibers and polyethylene yarn, the material is then dipped into boiling water. This causes the polyethylene to shrink, producing attractive sculptured effects.

One of the important recent trends in seat covers has been the rapidly growing popularity of heavy-gage transparent vinyl covers. A recent ASCMA report stated that sales of clear plastics covers had risen 34% in the past six months, and now constitutes more than 25% of all unit and dollar sales. The (*To page* 244)

King-sized vinyl sheeting

As stated in the accompanying article on the uses of plastics in auto seat covers and trim, Southbridge Plastics Div., Golding Bros. Co., Inc., recently installed a new press to produce 40-gage press-polished transparent vinyl sheeting in sizes up to 55 by 110 in. for use in convertible rear windows. The material is made by bonding two sheets of calendered 20-gage stock with a solvent binder, then press-polishing the sheets between stainless steel plates. The photo at left, below, illustrates automatic stacking of the press-polishing plates and the one at the right shows the stacks of sheets and plates being fed into the multi-platen polishing press. Protected by non-stick tissue, the press-polished vinyl sheets are rolled and sealed in individual polyethylene bags before shipment is made.





Helicopter about to be launched. Rotor blades are of high-density polyethylene; fuselage, wheels, and passengers high-impact styrene; tail fin regular polyethylene

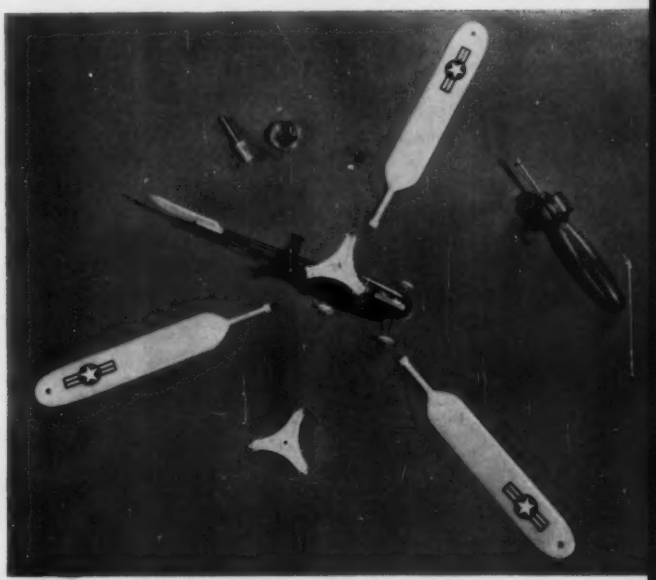
Toy is true helicopter

Clever design of molded polyethylene blades gives flight action similar to that of full-size vertical flight craft

Six different plastics go into the manufacture of a new toy helicopter now being marketed by BW Molded Plastics, Pasadena, Calif. An improved version of the German model that was a popular success last year, the BW 'Copter has been designed to sell for $2.98, compared with $4.98 for the imported model. BW is making the toy under an exclusive licensing agreement with the German firm.

Design secret of the 'Copter's success is the fact that the rotor blades change their angle of attack on the air, depending on their speed of rotation—just like the real thing. Metal weights at the end of each rotor provide a strong centrifugal force that pulls against steel springs connecting the blades to the central hub. A curved "track" within the hub twists each blade as the centrifugal force pulls it out against the spring. The result is a low angle of attack when the rotors are spinning fast, and a high angle when the rotor is coasting to a stop. The change allows the 'Copter to glide to a landing.

The blades themselves are (*To page* 250)



Exploded view of toy 'copter, showing the various plastics parts. Assembly of unit takes approximately 5 minutes

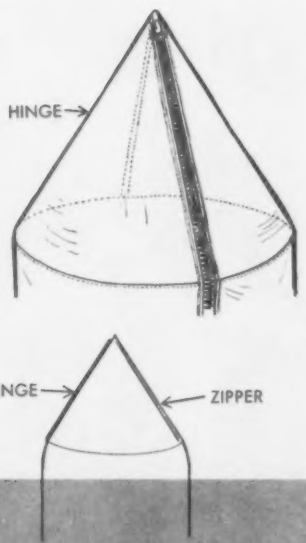
Launching mechanism has housing of acetate; nylon monofilament pull string revs up rotor blades

Raincoat for the Corporal

Protective weather-cover for 45-ft. long missile is fabricated of vinyl-coated nylon, held together by zipper system

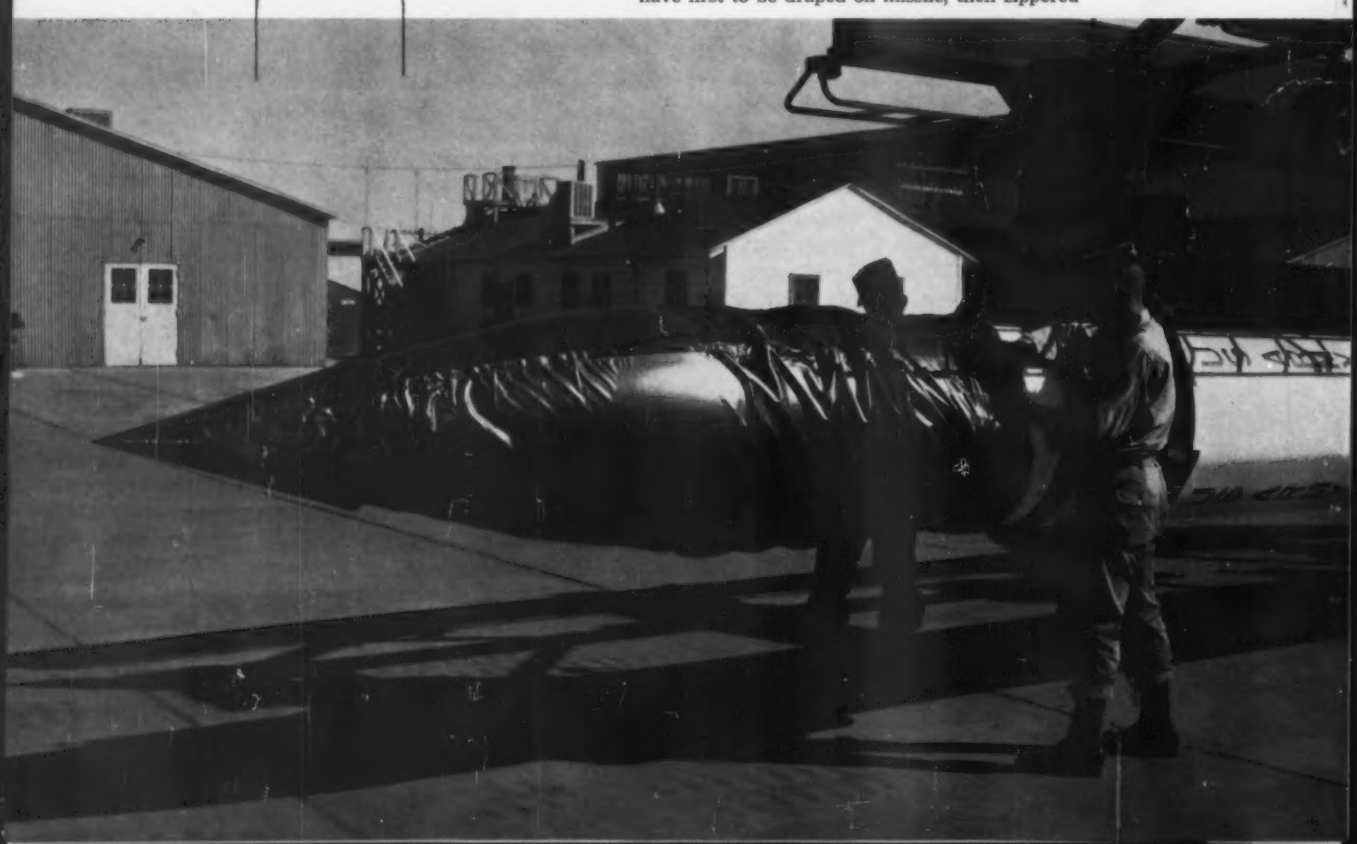
Preparing a missile for firing is a difficult enough task in perfect weather. For Army Ordnance troops in the field, who must fire the Corporal missile in any kind of weather, the task has been somewhat simplified by the use of a unique plastics raincoat that covers the missile from top to bottom, yet allows easy access for last-minute checking and maintenance.

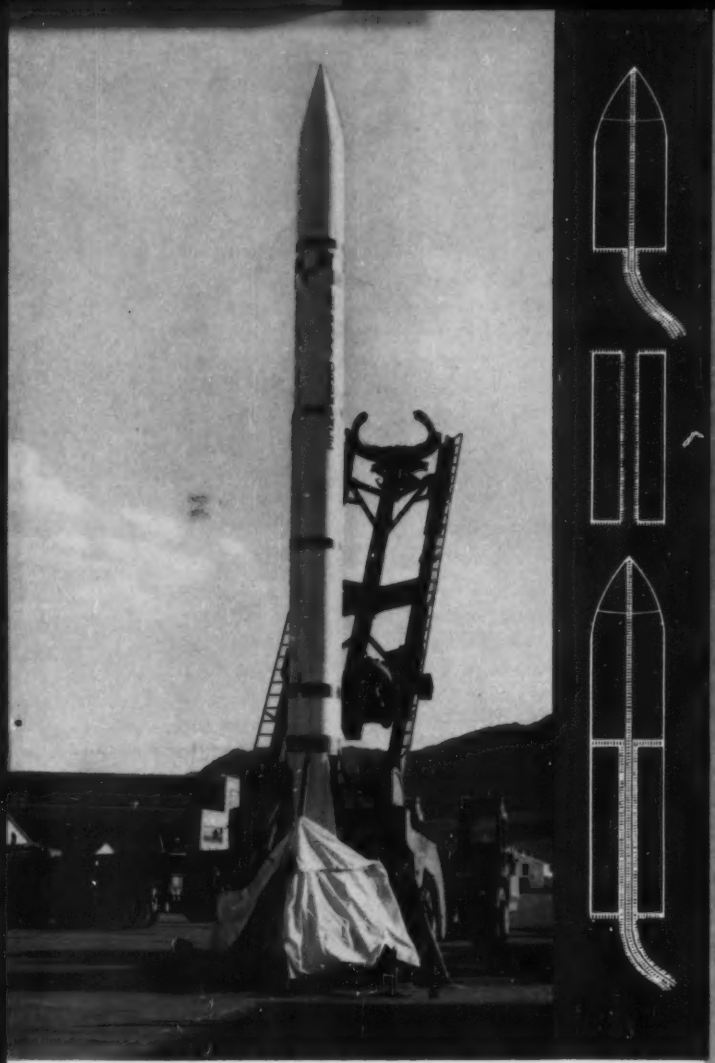
The Army's Corporal, designed and de-



Clam-shell construction of reinforced phenolic nose cone, whose sections are connected by flexible hinge, prevents cover from jamming zipper as it is being opened

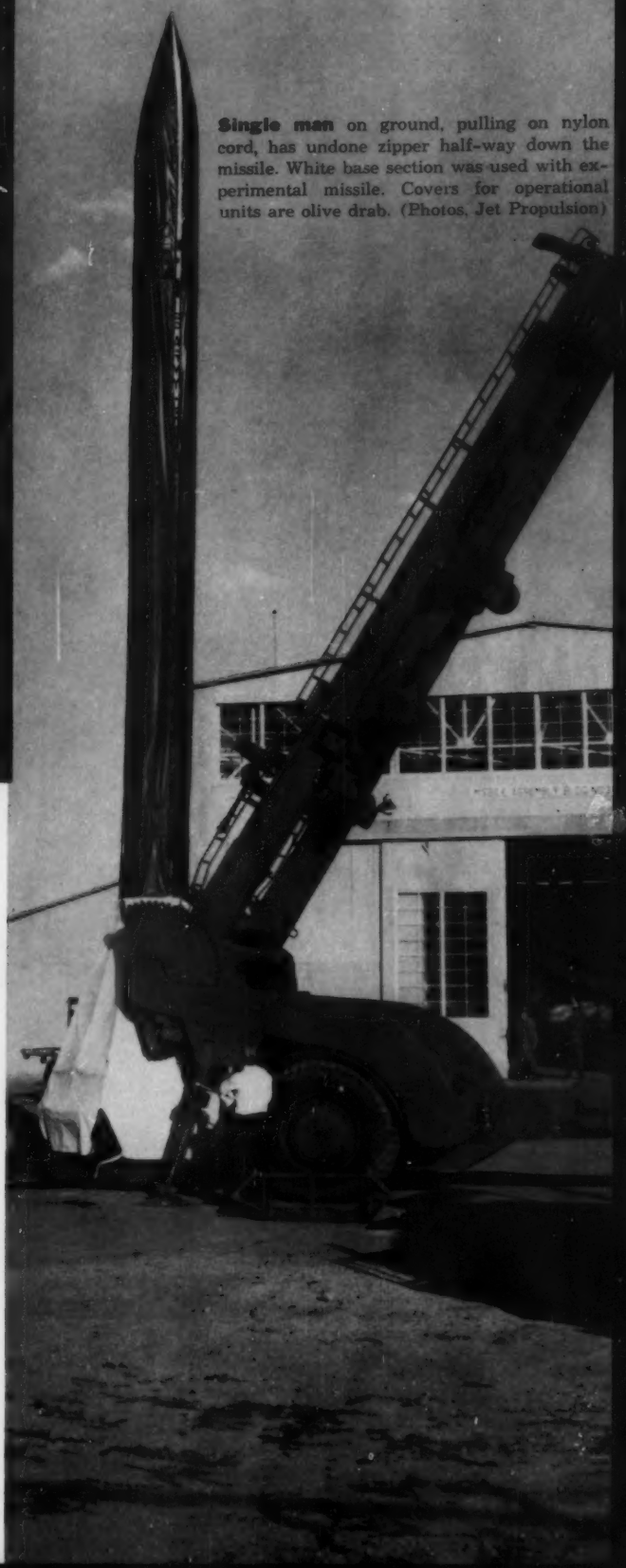
Nose section being put on missile is zippered in advance for easy slip-on. Center and tail sections, to be put on later, have first to be draped on missile, then zippered





Missile, divested of its "raincoat," in firing position. Except for emergency conditions, cover is pulled free of base of missile before firing

How sections are zippered together: vertical zippers on bottom sections are opened and zipper extension from upper section inserted between them, so that one continuous zipper extends from nose of missile to ground



Single man on ground, pulling on nylon cord, has undone zipper half-way down the missile. White base section was used with experimental missile. Covers for operational units are olive drab. (Photos, Jet Propulsion)

veloped by the Jet Propulsion Laboratory, California Institute of Technology, is 45 ft. long and weighs 5 tons. Packed into its aluminum shell are an electronic guidance system, tanks of highly volatile liquid propellants, a warhead, and a rocket motor. Erected on a portable launching platform, possibly near the enemy's forward observation posts, the Corporal must sometimes remain in this vulnerable position many hours before the final countdown. If the missile is to reach its target, every one of its components, every sub-assembly must function perfectly.

The Corporal weather-cover is a marvel of plastics engineering and ingenuity. Seven different thermoplastic and thermosetting resins are used in its construction. It has withstood a

year and a half of continuous weather testing with little or no sign of wear. It is assembled in three sections, zippered together around the missile circumference, yet one of the requirements for the cover is that it can be removed, just before firing, by pulling on a single 45-ft. zipper that reaches from nose cone to launching platform. The covering is constructed so that when one of the service ports is opened, a small "tent" automatically protects both the men and the missile interior. And all this has been built into a covering that weighs less than 50 lb. and can be packed into a carrying bag no larger than a suitcase.

Carrying case for missile cover is made of same material as cover itself. All three sections, including phenolic nose, fit into case. Total weight is less than 50 pounds

Something better than canvas

The need for some sort of covering for the Corporal was apparent from the first firing days at the White Sands Proving Ground and, in the traditions of the pre-missile Army, such a cover was made out of canvas. But what might have been fine for a field artillery piece was eminently unsuitable for a 45-ft. missile. When wet, the canvas weighed hundreds of pounds; in fact, a man was injured one day by the falling cover. Moreover it took valuable minutes to strip the canvas from the missile, and access ports were difficult to design and keep dry.

This was the situation when Fred Sindars of Airconductors Ltd., Gardena, Calif., first heard about the problem two years ago. He had just helped to design a fireproof firing cable for the Corporal, and this had prompted the White Sands engineers to ask his advice on the cover problem.

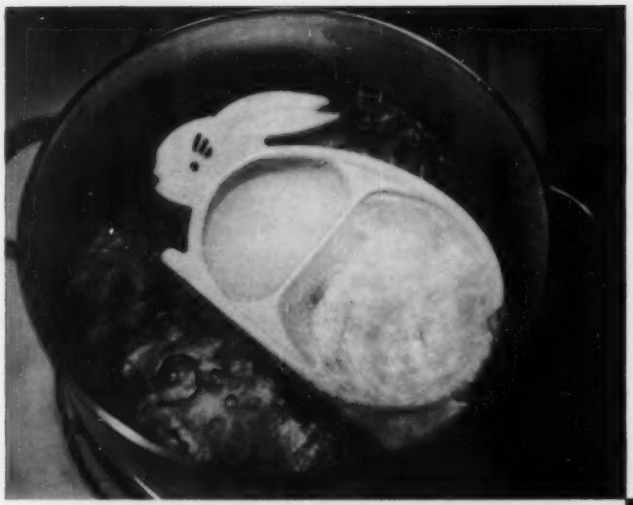
Sindars' first answer was a disposable, unsupported covering made of vinyl, to be slipped over the nose of the missile in one piece. A single, long extruded-vinyl zipper served as an opening device. The idea was to set the missile on its launching platform, perform final servicing operations, and then wrap it in the cover until just before the firing.

Something more permanent

Field experience proved, however, that the lightweight cover with the plastic zipper had its limitations. The zipper was easily distorted during the folding and storage, resulting in a faulty opening action or leakage. It was impractical to switch to a metallic zipper on such a lightweight, expendable cover.

The answer, obviously, was a heavier-weight, more permanent cover, and a number of advantages in such a change soon became apparent. With a more durable material in the cover, chances of damage during installation would be greatly reduced. More complicated parts and openings could be incorporated. A standard zipper could be used. Moreover, calculations indicated that such a cover need be used only five times to match the cost of the disposable covers. Starting with the sixth use, savings could be realized. Subsequent experience has shown that the covers can be used dozens of times.

Working closely with engineers from the Jet Propulsion Laboratory, Sindars developed a one-piece cover made of nylon cloth coated with a variety of neoprene and polyvinyl chloride formulations. A number of different fabric-plastic combinations were purposely used in order to test their permanence. At the start, for example, a nylon-neoprene combination seemed best, but after six months, the fabric stiffened, making it susceptible (*To page* 252)



FOR BABY–

it had better be boilable

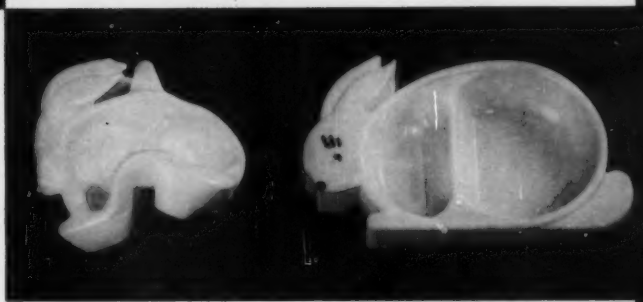
Rabbit-shaped infant's plate, molded of polymethylstyrene, can be boiled without damage. (Photos, American Cyanamid Co.)

Polymethylstyrene, a new plastic introduced commercially only a few months ago, is already establishing a firm foothold in the fertile field of babies' toys and feeding utensils. With properties otherwise very similar to those of styrene, the material has one characteristic that makes it a natural for this market: a heat distortion temperature of 215° F., high enough to permit boil-sterilization without distortion, cracking, or color change.

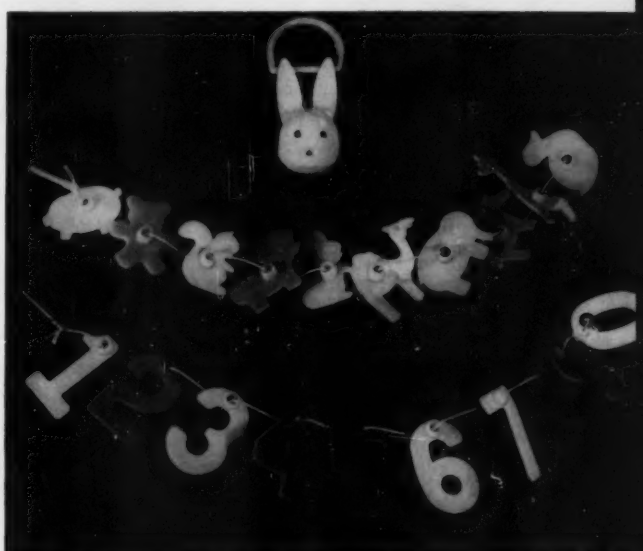
For mother this means one less worry about baby's health; for baby it means less chance of getting sick; and for Mr. Businessman it means a powerful new merchandising gimmick: a label that says "boilable."

Recognizing the market potential, North Star Industries, Inc., Hopkins, Minn., is now injection molding a line of polymethylstyrene infants' dishes, bowls, cups, and toys for nationwide distribution through jobbers to supermarkets, department stores, and similar outlets. The company had previously molded these items of regular polystyrene. The switch-over to the new material did not involve any change in existing equipment or molds and required only minor modifications of molding cycles (necessary primarily because of the higher heat distortion temperature of the new material).

Credit: Cymac 400 polymethylstyrene by American Cyanamid Co., New York, N.Y.



Polystyrene dish (left) after 30 min. in boiling water. Polymethylstyrene dish (right) after being boiled for same length of time



Boil-sterilizability of polymethylstyrene makes the material ideal for use in molding colorful and sturdy educational toys

Low-cost complex tools

Tooling plastics, often tailored for special purposes, offer advantages of rapid duplication and ease of alteration

By C. D. Charles and F. N. Peterson†*

Fig. 1: A lightweight combination drill fixture-and-scribe templet fabricated from glass cloth and epoxy resin is one of a number of plastics tools used by General Electric to reduce costs and speed tooling time in the manufacture of jet engine parts

An average saving of 20% in both time and cost by the use of plastics tooling materials in the manufacture of jet engine parts has been realized by The Component Manufacture and Engine Rebuild Section of General Electric Co. The tools, gages, and dies involved in this work are complex and require extremely close fabrication tolerances. An extensive development program has shown that plastics are applicable to an ever increasing number of prototype and production tools.

Through the years, hand work in the tool room has been reduced gradually in the development and introduction of precision machines; however, the highly complex and close-tolerance shapes and contours that machines cannot duplicate economically still require the hand work of the highly skilled craftsman for conventional tooling materials. It is in this field that plastics have made some of their greatest contributions, especially where multiple duplications of tools are necessary.

Like tool steels, there are many types of tooling plastics. Some are for broad general applications, others for special purposes. Although the formulators provide excellent data regarding the capabilities of their package products and their uses relative to physical and chemical properties, dimensional stability, temperature characteristics, and resistance to chemical attack, even more desirable properties for specific applications are possible by special formulations. Increasing or decreasing the quantity of additives, such as aluminum powder, steel flake, powdered carbide, or glass fibers, presents a wider application area from a basic formula and improves certain character-

*General foreman—Tool Room, and †Mfg. engineer—Low-Cost Tooling, Production Engine Dept., General Electric Co., Aircraft Gas Turbine Div., Cincinnati, Ohio.

istics of the finished tool. However, machinability of the finished tool is affected by the additives and deviation from the formulator's recommended usage should be avoided except on an experimental basis for the purpose of developing historical data for specific applications.

The American Society for Tool Engineers and The Society of the Plastics Industry are expending considerable effort towards establishing standards for the plastics tooling field.

Personnel training

Even more important than the industry standards is the need for personnel training and education within the areas of planning, designing, and fabrication and use of components involving plastics tooling. Initial training at General Electric consisted of a concentrated course for plastic briefing and orientation, and included representation from planning, manufacturing, engineering, tool design, and the tool room. Supplementary courses for planning and designing, covering the practical application of plastics in special-purpose tooling constitute a continuing program of education and training.

Examples of savings

Examples of the time and cost savings realized by the Component and Engine Rebuild Section on a representative set of tools show the time and cost-saving potential that can be realized as the result of such a program. The tools involved include forming dies, draw dies, drill fixtures, scribe fixtures, and chuck jaws. One of these tools, a light-weight combination drill fixture and scribe templet, is shown in Fig. 1. Tool construction was glass cloth and epoxy resin.

The tools in this group, by conservative estimate, would have cost $73,500 if fabricated completely from steel. Actual cost, using steel and plastics combinations, was $45,915. Tool performance exceeded expectations. The plastics-steel combination cost 37.5% less than conventional all-steel tools; there was a time saving of 23.16 percent.

Time and cost figures used here deal only with the actual construction of the tools. Tool layout or tool proofing time and costs are not included. Substantial savings, particularly in the case of die work, can be realized in this field alone. Conventional steel dies involving Kellering or contouring require considerable spotting of the punch and/or die to each other or to models. Valuable press time is necessary to spot in the proper metal clearance. Plastic, on the other hand, can be cast directly to the model and, by using sheet wax, the proper metal clearance can be cast into the punch and die.

Tracing templets

Tracing templets for duplicating contoured parts heretofore have required a considerable amount of handwork. A hard tracing surface was necessary. Heat treat distortion with the steel templets resulted in high costs and long lead times.

Such a templet, Fig. 2, was made from ¼-in. steel stock. The tracing face required accuracy within 0.0005 in. and a 32-micro-inch finish. Dimensional stability and wear resistance also were necessary. The cost of multiple steel

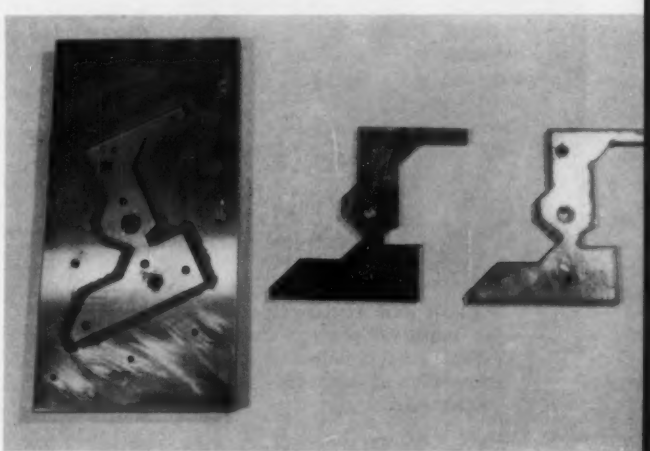


Fig. 2: Epoxy-faced tracing templet (right) is produced by casting resin around rough-sawed steel plate (center) in aluminum master (left)

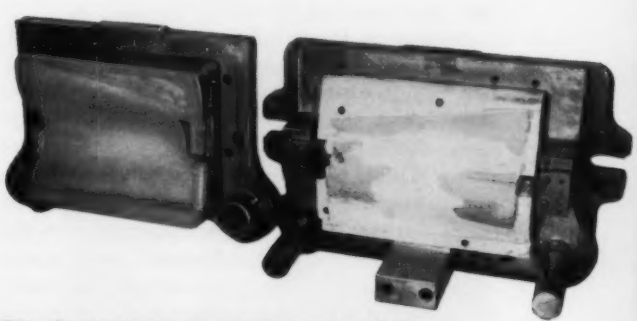
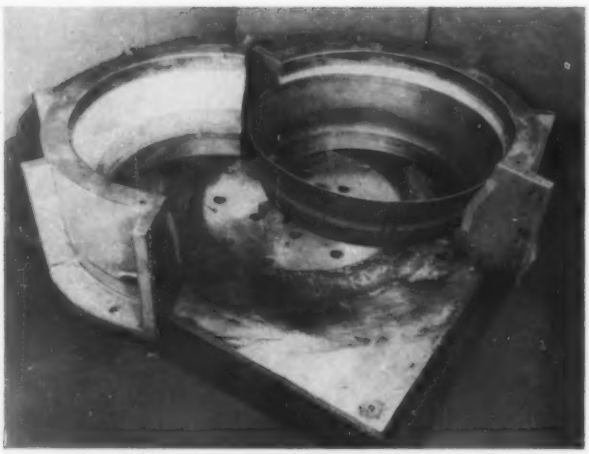
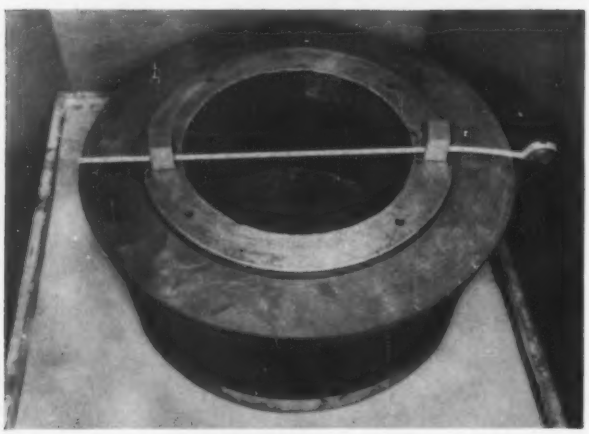


Fig. 3: Resilient epoxy-faced punch and die can be easily worked to eliminate spring-back problems in tooling. (Photos, G-E)





Figs. 4 and 5: Experimental rubber forming punch and plastic die offer advantages of earlier product introduction and rapid incorporation of engineering changes—with low tooling cost

templets would be the same as the original. An 80% cost saving was realized when duplicate templets were made from plastic. The basic process is as follows:

Aluminum is used for the master templet, eliminating the ever-present heat-treat distortion problem encountered with hardened steel templets. A steel plate is rough sawed to approximately ⅛ in. under the line scribed onto the steel plate from the aluminum master, which allows approximately ⅛ in. for the plastic face coat. The steel plate is then positioned in the master pattern and carbide-reinforced epoxy is poured around the plate. After the epoxy has cured, the top and bottom (not the tracing face) are surface-ground to remove excess plastic. This method has consistently produced templets which had an accuracy to within 0.0002 inch.

Such plastic templets have exceeded the wear life of conventional hardened-steel templets. In addition, multiple plastic templets can be produced from the original pattern in a matter of hours. Engineering changes involving contour change are accomplished by modifying the plastic templet at a fraction of the cost and time. Depending upon the area and direction of the change, steel templets would require complete replacement.

Forming dies and punches

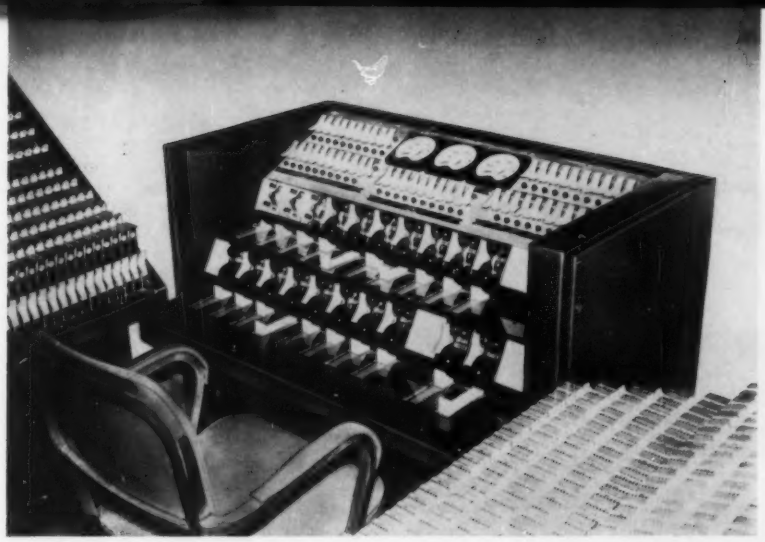
Plastics forming dies, where irregular shapes are involved, have proved both practical and economical. Either the punch can be plastic and the die steel, the die plastic with a steel punch, or both the punch and die can be plastic. Conventional dies require as much as 50% of construction time and costs to tool proof. This can be accomplished only by barbering and welding. Matching the punch and die for proper metal clearance is time consuming and costly. Die marks in weld-altered areas are often detrimental. Plastics, on the other hand, can be recast or patched in a fraction of the time with much less cost—and die marks are negligible.

Figure 3 shows an epoxy die with a resilient epoxy punch. Both punch and die were cast to flat cold rolled steel base plates. This type of tooling can be used, because of its easier working characteristics, as a means of determining the exact duplication in steel, thus eliminating the majority of spring-back problems encountered in tool tryout.

For rubber forming dies

Plastic is an ideal mate for rubber forming dies. An experimental example is shown in Figs. 4 and 5, in which an epoxy casting plastic reinforced with steel wool fibers is used. Such a combination reduces metal spring-back of the formed part to such a degree that its effect is considered negligible. The plastic portion of the punch or die can be cast to exact print dimensions, thus eliminating the costly and time-consuming tool proofing. Other factors such as facilities and quantities must determine if this is to be the final production tool. The flexibility of this kind of tooling permits earlier product introduction and more rapid incorporation of engineering changes, with a lower tooling cost.

The utilization of plastics (*To page* 258)



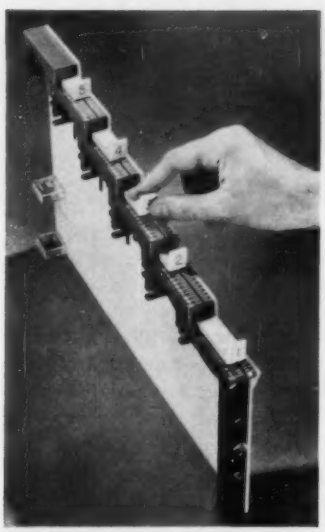
Console of lighting control system has molded urea handles and slide bars (see detail below) which are produced in five different colors as a means of quick identification by the operator. (Photos, American Cyanamid Co.)

2500 molded urea parts

Molded urea parts—as many as 2500 in one unit—play a number of utilitarian roles in a new stage lighting control system called Lumitron. The system permits infinite variations in stage lighting effects, yet needs only one operator. Instead of having to control physically the intensity of a number of lights, the operator of the Lumitron console can preset lights and with one lever, during a performance, simultaneously control many circuits. In effect, the console is the organ, the operator the organist, and the light movements the musical sound.

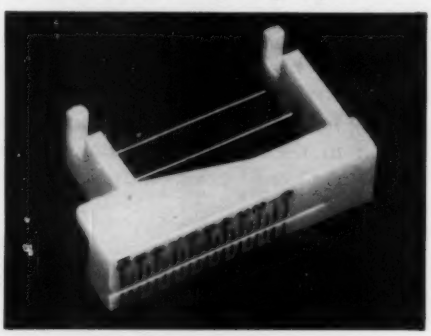
The control system has proved to be especially useful in major television studios, theaters, schools, and public auditoriums. Its record of dependable performance is exceptional. Contributing to this dependability are the console preset units, the handles and slide bars of which are molded of urea plastic. This material, an excellent dielectric in itself, requires no additional insulation. It is durable, resists scratching, and has a hard self-surface that cannot wear off. The slide bars are produced in five colors as a means of quick identification for the console operator. The moldings are standard parts which are made up into custom built units. The rest of the working surface of the console unit is mainly made of black or white acrylic.

Credits: Console by Lumitron Div., Metropolitan Electric Mfg. Co., Long Island City, N. Y.
Urea parts molded by Accurate Molding Corp., Long Island City, N. Y., using American Cyanamid's Beetle material.



Slide-bar components are assembled into units which are combined into banks

Graduated scales molded into slide-bar bases enable presetting of lighting conditions



Plastics in

Fig. 1: The Wisconsin Solar Cooker consists of a reflector formed of 50-mil high-impact polystyrene and lined with aluminized Mylar, mounted on a ¾-in., thin-wall tubular steel frame. Cooker can bring a quart of cold water to boiling in 15 min. on a clear day

Fig. 2: Ribbed, drape-formed styrene reflector shell being lifted off mold. Shell may be formed with aluminized Mylar film laminated to it, or film may be applied in adhesive-tape form to already-formed shell. Radial ribs add rigidity to reflector, insure retention of parabolic shape. (Photos, University of Wisconsin)

A small fraction of the energy we receive in sunshine, if it could be economically collected and distributed, would be enough to supply all our energy needs. However, the intensity, or concentration, of this energy is low, and about 85 w./sq ft. is the maximum that we receive This energy level is high enough, without optical concentration, for domestic heating and desalting of sea water.[1] However, for many other purposes, such as solar cooking, the energy must be concentrated by focusing the rays falling on a large area onto a much smaller area. This can be done by curved reflectors, and the increased intensity of the energy can produce much higher temperatures than can the unconcentrated energy.

Many focusing solar reflectors have been described in the technical literature;[2] they include precise, silvered-glass, parabolic mirrors, segmented glass and metal reflectors, and conical, cylindrical, and spherical reflectors. All have shared the common drawback of high cost for the amount of heat delivered. In non-industrialized areas, particularly those which are arid, a low-cost solar stove could fill a real need. A parabolic aluminum reflector 3 ft. in diameter was developed by the National Physical Laboratory of India and preliminary production models were sold for about $15.00 retail, but it was not a commercial success.

The most common shapes of focusing solar reflectors have been the parabola of revolution;

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†University of Wisconsin and Bjorksten Research Laboratories.
‡University of Wisconsin and Chemical Engineering Consultant, Denver, Colo.

[1]See "Plastics in solar stills," MODERN PLASTICS 34, 266 (June 1957).

[2]Bibliographies of this literature are given in "Applied solar research," edited by E. J. Burda, Stanford Research Inst., 1955; and in "Solar energy research," by F. Daniels and J. A. Duffie, 9 ed.), Univ. of Wisconsin Press, Madison, Wis., 1955.

SOLAR STOVES

Focusing mirrors fabricated from plastics make low-cost "one-burner" stoves for non-industrialized areas

By J. A. Duffie, R. P. Lappala†, and G. O. G. Lof‡*

while the cylindrical type is easier to fabricate accurately (it has only one direction of curvature), it does not do as good a job of concentrating the sun's heat. The dish-shaped section, which gives the desired concentration, is easily formed from thermoplastic sheet. A thermoformed-sheet reflector might also be made at a low enough cost to compete with fuels available in the areas for which it was intended.

Reflector design factors

Design problems are of two kinds: those involving the reflecting surface itself, and those involving its supporting shell and structure. For high efficiency, the surface must reflect in a mirror-like fashion nearly all of the incident heat energy, and must either retain its reflectivity over long periods or be easily and cheaply renewable. Thus, resistance to weathering, abrasion, and solvents, and the ease of cleaning of the reflecting surface all affect the cost of the energy collected with it.

The greater the concentration ratio desired, the more precise must be the construction and positioning of the cooker. The two solar stoves discussed here have concentration ratios in the range of 100 to 400 (high-temperature solar furnaces have ratios of up to 40,000). One of the cookers, intended for every-day use primarily by people of non-industrialized areas, has a one-piece, rigid parabolic reflector with a diameter of 43 in. and a focal length of 18 inches. It is shown in Fig. 1, opposite. This cooker supplies about 650 w. to a pot or pan when in direct sunlight, at a surface reflectivity of 80 percent. The mounting is simple and the vertical and horizontal angles are manually adjustable; the shell was drape- (*To page* 260)

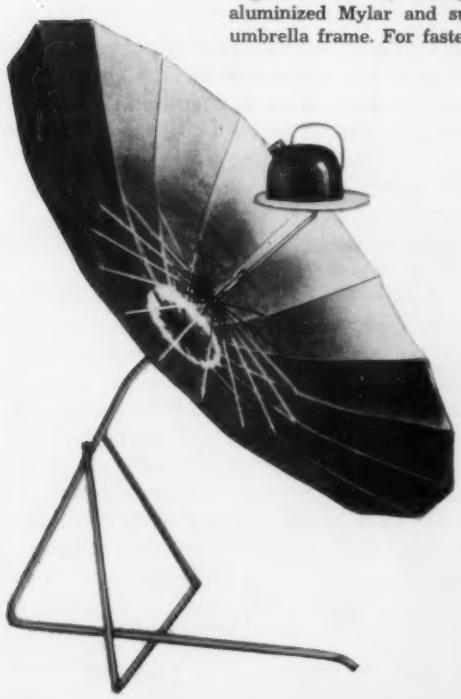
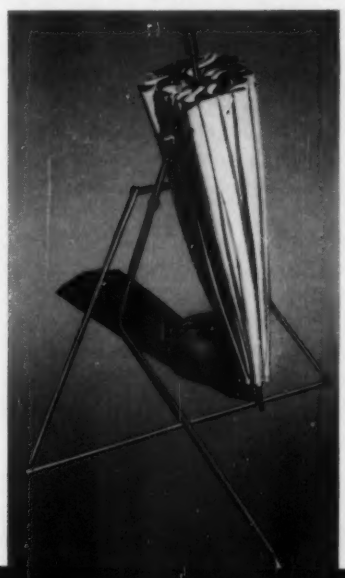


Fig. 3: Portable, folding-type cooker is made of a laminate of aluminized Mylar and supported vinyl, mounted on a standard umbrella frame. For fastest heating, pot should be dull black

Fig. 4: When not in use, vinyl-cloth-Mylar cooker can be folded like ordinary umbrella



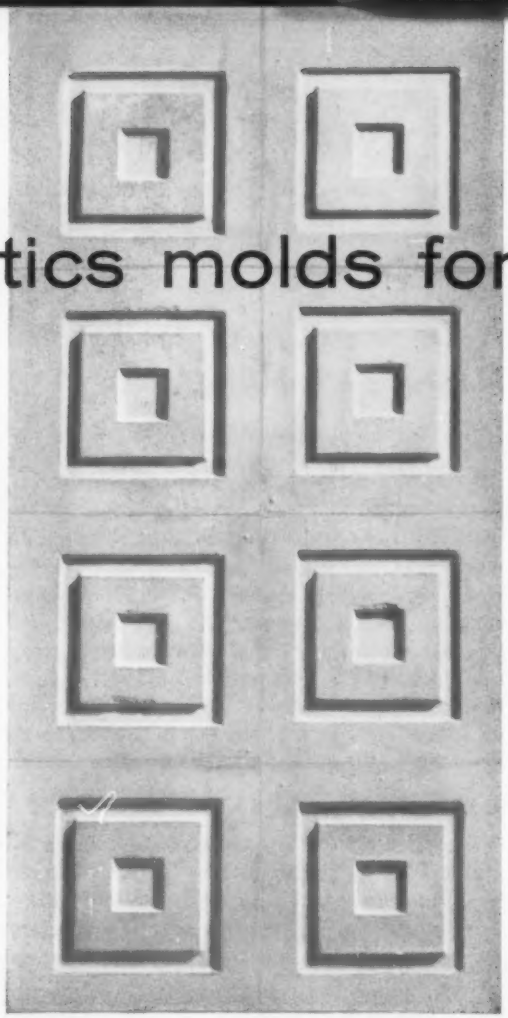
Reusable plastics molds for

Similar in principle to the toy molds used by children in making sculptured wet sand castings at the seashore, a recently developed type of form liner fabricated from specially formulated thermoplastic sheet stock now opens the way to completely new and original concepts of integral decoration for architectural concrete.

The plastics form liners, which offer a number of features unavailable with other types of liners, will be made up to architects' designs by a number of distributor-fabricators throughout the country. The form liners were developed by a major manufacturer of thermoplastic sheet stock.

Through use of the plastics form liners, a virtually unlimited choice of three-dimensional designs may be cast directly into the face of concrete surfaces. They are applicable to precast units, concrete masonry, and cast-in-place work. Size of the individual designs may range from 1 ft. square or smaller units up to approximately 4 by 7 ft., being limited only by the platen area of the vacuum forming machine used in producing the liners.

When used in concrete forms, the plastics liners create patterns of constantly changing appearance—the result of the depth of relief and plan of shadows on the finished surfaces. Colors, which may be incorporated directly in the concrete through addition of such materials as iron oxide or dispersed carbon, assume rich, striking hues because of the glassy smoothness of the surfaces which can be imparted by the liners. Quality of color can be closely controlled from batch to batch. The combination of patterns and colors now available to the architect or designer should find many interesting expressions in precast decorative wall panels, concrete block facings, spandrel facings, and other building components.



Typical concrete panels cast in vacuum formed plastics form liners illustrate design potential of new technique. Play of shadow and light produces variations in pattern

Other liner materials

Heretofore, various materials ranging from fiber-reinforced plaster to wood, textured rubber sheeting, and stainless steel have been used for form liners to obtain surface textures and patterns in concrete. Most of them involve a major expenditure of time and the use of special tools. In one "waste mold" process, original designs are sculptured in clay and translated into an expendable plaster liner. These liners provide almost unlimited latitude of pattern and size, but are quite expensive because they are destroyed after a single use. Textured rubber strips, widely used as a form liner, do an excellent job but are limited to relatively shallow grooves and other effects.

Wooden form liners, frequently used to impart a grained texture to concrete surfaces, cannot be reused repeatedly because they tend to absorb water and warp. Plywood form liners are used extensively when decorative aggregates such as marble chips are to be incorporated into the exterior surface of cast concrete units by the aggregate transfer method. However, these molds do not lend themselves to casting deep or highly detailed designs into concrete.

PATTERNED CONCRETE

By vacuum forming a thermoplastic sheet material having the required properties, it is possible to produce form liners which are light in weight, easy to handle, rustproof, dentproof, and sufficiently strong to withstand the weight of the poured concrete without distortion. The liners will fit any forms, they are easy to store, and save labor because they require no grinding or polishing. The smooth surface of the plastics liners, combined with the flexibility of the material, permits them to release readily from the hardened concrete; no form oil or other type of release agent is required which might spoil the color uniformity of the surface. As soon as a used liner has been washed with water, it is ready for another casting operation. Each liner may be used ten or more times before requiring replacement.

Easy to release

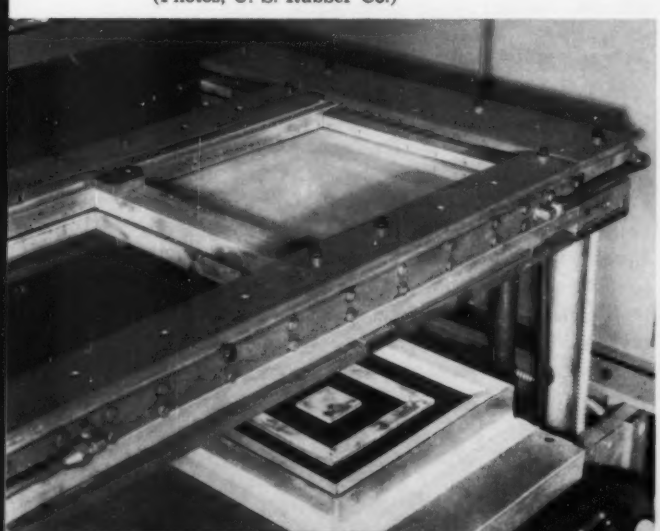
Ease of release after the concrete has set up speeds construction operations and helps to insure a maximum number of uses for each liner.

During the preliminary research program, a number of sheet formulations were tested until the presently approved specially compounded sheet material was developed. The sheet material is produced in thicknesses of $\frac{1}{16}$ and $\frac{3}{32}$ in., with one side perfectly smooth and the other having a lightly grained surface. Form liners may be made with either surface against the concrete, depending upon whether the cast concrete face is to be smooth or textured. Preliminary indications are that smooth surfaces will probably be confined for use in interior installations where weather will not be a factor and that textured surfaces will be used in outdoor applications.

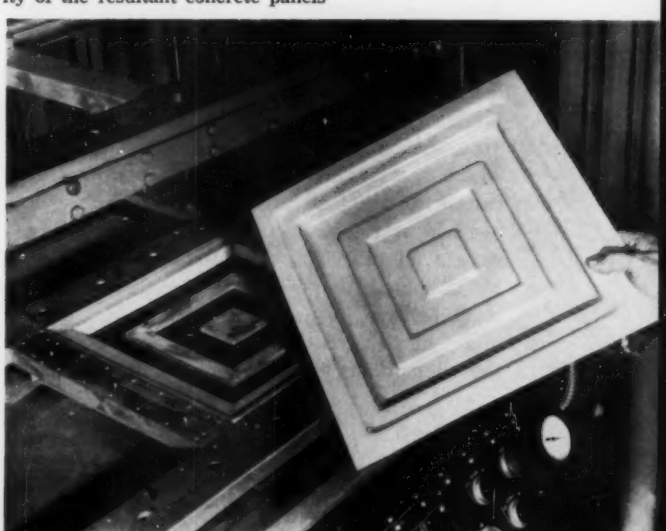
No special concrete needed

The flat sheets of plastics may be formed into decorative form liners on conventional vacuum forming equipment, using inexpensive molds made of wood, plaster, and other materials. The semi-flexible liners are then ready for use as soon as they have been placed in the conven-

Decorative architectural concrete form liners are produced of thermoplastic material by standard vacuum forming techniques. Below, heated sheet is in position above mold. (Photos, U. S. Rubber Co.)



Finished form liner being removed from mold at end of cycle. These liners can be used ten or more times without affecting the quality of the resultant concrete panels



tional forms. When a number of designs are to be incorporated in a single large pour, the required number of individual form liners is placed in the outer form.

The concrete used with the plastic liners does not have to be a special mix to obtain castings of high luster. Any good mix made in accordance with accepted trade procedures may be used. Use of an air-entraining agent is recommended to improve the workability of the mix and provide a more durable concrete, and vibration is required to insure that all air bubbles are released from the face of the liner. In making precast concrete panels, this can best be accomplished by use of a vibrating table. The concrete should remain in contact with the liner for from 48 to 72 hours. For best quality concrete, the backs and sides of the panels should be covered with a waterproof membrane, such as polyethylene film, during the curing period.

One of the largest applications of the new plastics form liners is expected to be with concrete masonry blocks. With a single, simple design cast on the face of concrete blocks, patterns can be made that are distinctive and visible even from a distance. An architect can achieve several effects with a single block design merely by varying the pattern in which blocks are combined in the finished installation. Custom-made block face designs, easily possible with the thermoplastic form liners, allow limitless pattern variations. The liners will also produce plain surfaces that have the appearance of glazed block.

Other expected applications for the plastics form liners include precast decorative wall panels, patterned panels, precast sections for swimming pools, markers, table tops, spandrel facings, columns and beams, and components in dome-type floor construction. Casting directly against the grained side of the plastic sheet produces a non-slip surface that will be desirable around swimming pools and in other applications.

Churches, theaters, auditoriums, and a wide range of other public and private buildings can make use of the plastics liners to achieve striking decorative architectural treatments. Mottled effects are possible if a combination of colored and uncolored concrete is used.

Prepared concrete mix is placed in plastic form liner. On small panels like this, no outer retaining form, which would usually be made of wood, is used

After liner is filled, it is shaken on vibrator table. This operation releases any air bubbles that may have formed at the interface between concrete and liner

Back surface of panels is screeded for smooth texture. In the photo above, several decorative concrete panels have been cast simultaneously in plastic forms

Actual application

Some of the first actual applications of the plastics form liners are in the Portland Cement Association's new Fire Research Center building, now under construction adjacent to the PCA Research Laboratories at Skokie, Ill. Included in these applications is a series of 2-ft. square designs cast integrally on a group of 29 precast concrete columns approximately 35 ft. in height. The columns, weighing approximately 11½ tons each, were cast on the site in horizontal wooden forms, each having a series

Reproducibility with high degree of accuracy is one of main advantages of plastic form liners. Here more than 30 liners with same pattern are shown ready for casting of test panels

After concrete has been poured into form liners and screeded on back, sheet of polyethylene film is placed over panels to prevent excessive loss of moisture. Panels are normally left in forms from 48 to 72 hours. Removal is facilitated by flexibility of plastic liners

of the vacuum formed plastic liners laid in position in the bottom of the form before the pour was made. Strips of wooden molding placed between the form liners provide a smooth transition between the adjacent patterns. After a curing period of approximately 72 hr., the forms were stripped and columns lifted into vertical position by huge cranes.

On the entrance side of the same building, plans call for an additional group of smaller columns, which also incorporate cast-in exterior designs produced with plastics form liners. In the lobby of this building, a series of 12-in. square patterned panels will form a dramatic three-dimensional mural in colored concrete.

The plastics liners will be obtainable in various cities from qualified distributor-fabricators who will stock the basic sheets and also have equipment for vacuum forming them into desired patterns. Architects and designers will be able to specify special patterns. The finished liners will be delivered to the contractor, ready to be placed in supporting forms and used on the job site as required. The number of liners needed for a given job will depend upon the number of patterned concrete sections specified, number of different patterns involved, the construction schedule, and other variables.

It is also expected that proprietary producers of precast concrete blocks and related items will purchase their own supplies of form liners, enabling them to offer the building trades concrete blocks and other structural units having a variety of interesting design treatments.

Credits: Lustreform No. 2900 sheet stock for concrete form liners, Royalite Div., United States Rubber Co., Chicago, Ill.

Extruded wall panels

A new type of interlocking styrene striped wall panel can be installed quickly and easily on any flat surface. The panels, manufactured in 12 color combinations, are extruded of high impact styrene by a special process.

The panels are available in 1- by 8-ft. and 1- by 4½-ft. sections that will not chip, buckle, crack, or craze, and will resist damage even in the heaviest traffic areas. The new plastic panels are held together by a locking arrangement similar to the tongue-and-groove construction found in expensive wood paneling. The arrangement secures each joint, prevents loosening of the panels, and gives the appearance of one continuous, seamless application. Once installed, a wall of these panels is easily cleaned with a sponge or cloth dipped in a mild detergent solution.

Credits: Strypanel manufactured by Cermak Tile Co., Inc., Cleveland, Ohio; impact styrene by Catalin Corp. of America, New York, N.Y.

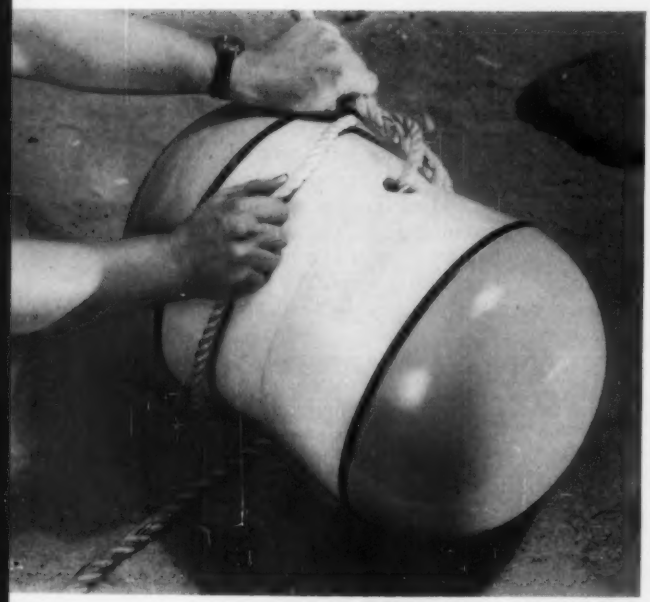
PLASTICS

Clear copolymer tumblers

A new set of plastic tumblers that are as clear as glass will resist both breakage by impact and prolonged immersion in boiling water. Molded of methylstyrene acrylonitrile copolymer compound, the tumblers combine attractive contemporary design with unusual durability.

The tumblers are resistant to fruit acids and can withstand wide variations in temperature, which make them usable with any type of beverage, hot or cold. The tumblers are especially useful for serving young children, who can hurt themselves and cause damage with ordinary breakable glass tumblers. Packaged in carry-away cartons, the tumblers hold a full twelve ounces. They are sold in sets of six, and are manufactured in three transparent colors.

Credits: Tumblers manufactured by Jaydon, Inc., New York, N.Y., of Cymac methylstyrene acrylonitrile copolymer supplied by American Cyanamid Co., New York, N.Y.



Butyrate buoys

Big, bright, three-color buoys of weather-resistant butyrate are being used to mark off swimming areas at heavily patronized beaches. Highly visible against the water, the markers are made in a red, yellow, and blue design. Colors don't chip or peel off in the salt water because they are an integral part of the butyrate. In contrast to the balsa buoys previously used, the first of the plastic buoys have been in service for several years without repainting.

Each buoy consists of six hollow injection molded pieces cemented permanently together to form an airtight enclosure. The parts are molded in individual cavities on a 48-oz. injection machine and the complete unit weighs about ten pounds. A groove molded into each of the two center parts provides an opening for stringing.

Credits: Buoys molded and assembled by Fibre Corp., Clark, N.J.; Tenite butyrate by Eastman Chemical Products, Inc., New York, N.Y.

PRODUCTS

Polyethylene ball game

Two polyethylene moldings serve to make up a new game: a lightweight scoop for catching and throwing, and a hollow ball tailored to the size of the scoop. The scoop is used much like a jai alai racquet, except that it is hand-held rather than tied to the player's arm. Thanks to the use of polyethylene, it is light enough to be handled with ease by children. The value of the perforated, 2-oz. Fun Ball is that it can be used indoors or in confined areas with little danger of breaking windows.

Because of the moisture and chemical resistance of the injection-molded polyethylene parts, they can be left outdoors without rotting, mildewing, or decomposing. Mud and dirt can be washed off with soap and water and, because of polyethylene's low density (0.92), the scoop and ball will float in water.

Credits: Scoop and Fun Ball manufactured by Cosom Industries, Inc., Minneapolis, Minn., of Bakelite polyethylene.

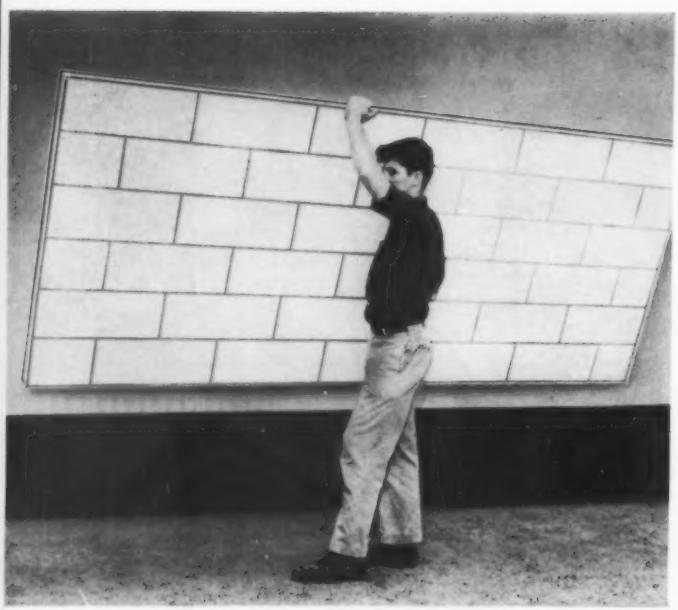
Cosmetic travel kits

Two new ladies' travel cosmetic cases are fabricated from vinyl film. The soft-textured, attractively printed vinyl gives the cases a smooth, warm feel to the touch, and a luxurious appearance. Designed like an evening purse, the case on the left has a pull-up handle of vinyl in a matching color, and a zipper around three sides. The compact case contains coordinated jars, bottles, and similar accessories.

The roll-up kit at right is decorated in the same "Starburst" pattern. Interior compartments of both kits are made of transparent vinyl film, heat sealed to the back. The kits are put together by electronic heat-sealing. They may be washed with soap and water, are resistant to most chemicals in cosmetics, and their soft surfaces will not damage other contents of a suitcase.

Credits: Travel cases manufactured by Trina, Inc., New York, N.Y., from Wataseal vinyl film supplied by Harte & Co., New York.

PLASTICS



Reinforced grid panels

Translucent curtain wall panels that provide exceptional design freedom at minimum construction cost are based on skins of fibrous glass-reinforced polyester bonded to an aluminum grid. Completely finished for both exterior and interior wall and roof surfaces, the prefabricated panels are available in four sizes and six colors.

The panels have excellent acoustical properties, provide non-glare illumination, and eliminate condensation problems because they are highly efficient thermal insulators. The building panels are also resistant to shattering, crazing, and fading. Weighing only 1.42 to 1.60 lb./sq. ft., depending on thickness, the polyester-faced panels are only one-seventh as heavy as equivalent metal sandwich panels, and can be handled easily by only one man, permitting rapid, economical installation on the building site.

Credit: Manufactured by Kalwall Corp., Manchester, N.H.

Water-ski suit

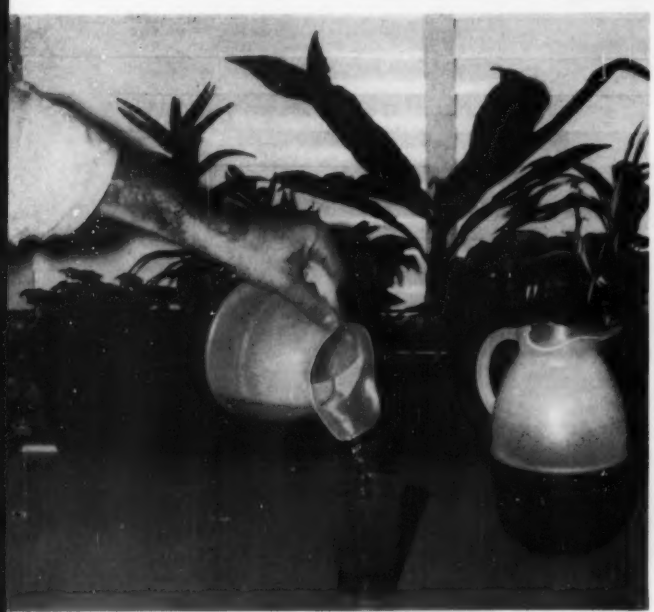
Lightweight Aqua-Suits of vinyl film now make it possible for water skiers to extend the season comfortably into cool weather by providing protection against chill winds and water. Made from 8-mil film and fabricated entirely by electronic heat sealing, the two-piece suit slips on and off quickly. The jacket has an adjustable elastic neck and waist, pants have an elastic waist band.

The bright yellow color of the Aqua Suit makes an easily seen marker of a spilled swimmer. The vinyl of the suit makes it soft and flexible; it does not shrink, mildew, rot, or become water-logged. The suit stays attractive even after long periods of constant use.

Besides its use by water skiers, the protective suit can be used for boating, fishing, and snow skiing. A range of sizes is available to assure comfortable fit for men, women, and children.

Credits: Manufactured by Plastimayd Products Corp., Portland, Ore., of Bakelite Krene vinyl film.

PRODUCTS



Two-color pitchers

Handsomely styled two-color pitchers of unbreakable polyethylene will brighten up any table setting. A pair of ranch-type pitchers is available in 1- and 2-qt. sizes. The two sizes and colors are obtained by joining two separate injection molded polyethylene parts by an automatic welding technique. Both pitchers use the same size top, with bases of different sizes.

The new polyethylene pitchers have sturdy handles that are molded integrally with the top section. The attractively designed containers also have molded-in ice catchers near the spout to prevent ice cubes from falling out of the pitchers while pouring. Deep rims molded integrally with the bottoms of the pitchers are designed to protect surfaces on which the containers are rested. The new pitchers are manufactured in a variety of different light-and-dark two-color combinations.

Credits: BW Pitchers manufactured by B. W. Molded Plastics, Pasadena, Calif.

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The unique combination of W.E.I. *dual worm* design and our unequalled research and development experience can solve your compounding-extruding problems with all-in-one-operation equipment . . . and *pre-prove* its *"quality-ability"* and *"rate-ability"*

● Name the most tantalizing of new plastics materials that defy the processing abilities of ordinary machines . . . They are on the success list with W.E.I. compounder-extractor-extruders. Struggle with new space-labor- and-cost problems in the material field where competition is keenest . . . and W.E.I. is on the most familiar of grounds! There are many reasons why W.E.I. has earned top priority position with those who know it pays to buy the best equipment. May we have the opportunity to discuss them with you in strictest confidence of your processes and plans?

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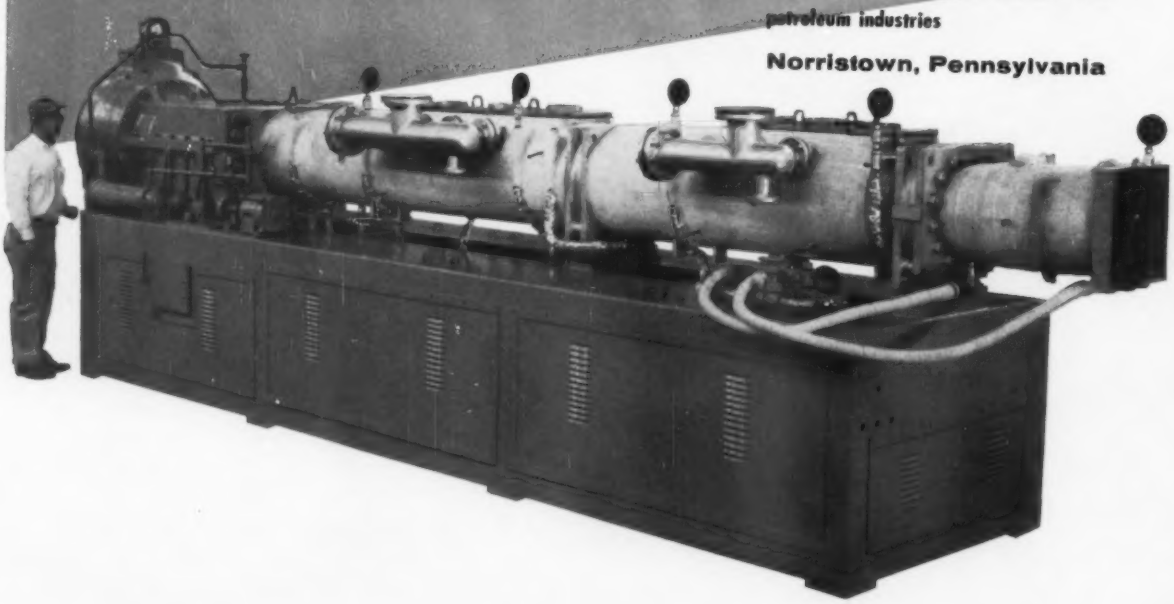


Dr. James F. Carley, Engineering Editor

Premix your own phenolics

Compounding of thermoset molding powder by the molder, already popular in polyester molding, is now possible with phenolics, and offers savings of 8 to 20¢/lb. on the high-impact grades, though savings on G-P materials are questionable. Properties of standard grades can be duplicated in the premixes, and with proper attention to premixing procedure, good control of powder quality is possible. Costs, recipes, equipment, premixing temperatures and cycles, and some proved applications are discussed.

By J. J. Colao†

Within the short span of some five years, reinforced polyester premix materials have captured the interest of many molders throughout the industry (see MODERN PLASTICS 33, 91, Aug. 1956). By using the inexpensive equipment of the premix process to prepare compounds on their own premises, large consumers have achieved, at a low capital investment, an economic advantage over the use of reinforced molding materials purchased from suppliers. These new low-cost polyester molding materials (approximately 20 million lb. were produced by molders in 1956) have found use in varied applications and have entered fields never before considered for plastics materials.

Phenolic molding materials, however, for many years the backbone of the plastic industry, have not appreciably increased in sales volume in the last five years (see Table I, p. 136), partly because no new applications or low-cost formulations have been developed to stimulate the industry.

The development of reinforced phenolic premix compounds and the practicability of the preparation of these molding materials by the molder is now an accomplished fact. As a result, phenolics are placed in a new light—and applications once rejected because of high cost can be re-evaluated.

Development

Premixes are prepared in kneaders or similar mixers which combine into a single operation certain steps in the preparation of phenolic molding materials. Unlike premix molding of polyester resins, phenolic premix molding is still in the formative stage and to-date only reinforced or impact-type materials have been prepared on a production basis.

Preliminary laboratory evaluations indicate that general-purpose materials can also be prepared in premixing equipment. Whether the economics of making these low-cost, high-volume materials are sufficiently attractive to molders is somewhat debatable

Housing for Admiral portable phonograph was compression molded of phenolic premix material. (Photos, Allied Chemical & Dye)

*Reg. U.S. Pat. Off.
†Shadyside Applications Research Laboratory, Barrett Div., Allied Chemical & Dye Corp.

Salad bowls, exceptionally light in color for products molded of phenolic, were made from a premix filled with alpha cellulose

and probably must be decided on an individual basis.

The physical characteristics of reinforced phenolic molding materials produced through the premix process, similar to those of standard impact compounds, are listed in Table II, p. 140. These materials do not appear stronger or superior to standard compounds but are, however, comparable.

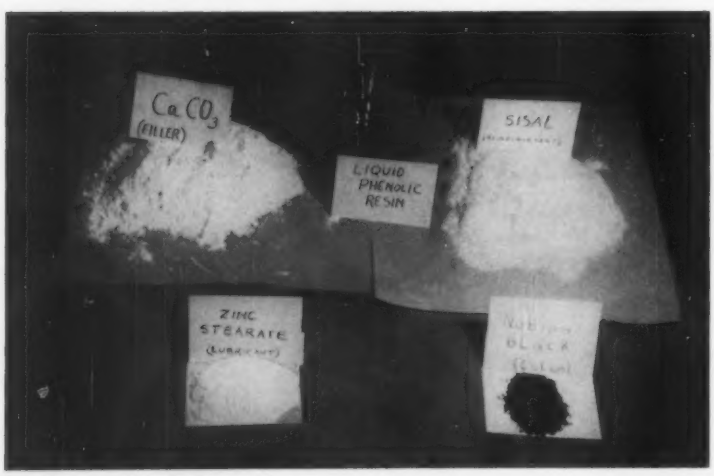
With the technical know-how now available, the molder can prepare good-quality reinforced phenolic premixes, although he can not expect to achieve immediately the refinements of superior finish, excellent preformability, and proper density—properties which have taken years to develop in standard compounds. Although information is available for general compounds, considerable development work should be anticipated in formulating specific compounds. Continuing progress is being made by molders and resin suppliers toward correction and improvement of premix materials and, important as existing shortcomings may be, the economic value of the process to the molder is even more important.

The savings which can be realized by the molder are shown in the cost analysis in Table III, p. 142. The approximate cost to produce satisfactory low impact phenolic material is 19.3¢/lb., as compared with standard prices of 28 to 40¢/lb. It should be noted, however, that this cost is based on an estimated 5¢/lb. manufacturing expense. The latter is, of course, dependent on the volume of material produced, overhead and depreciation, labor cost, etc., but is believed to be a generous estimate. Each molder will have to determine his own manufacturing expense based on his individual plant operation and investment involved.

Table I: Phenolic molding powder sales in recent years[a]

Year	*Millions of pounds*
1953	204
1954	172
1955	200
1956	190
1957 (est.)	185

[a]Source: U. S. Tarriff Commission, except last six months of 1957, which are estimated.

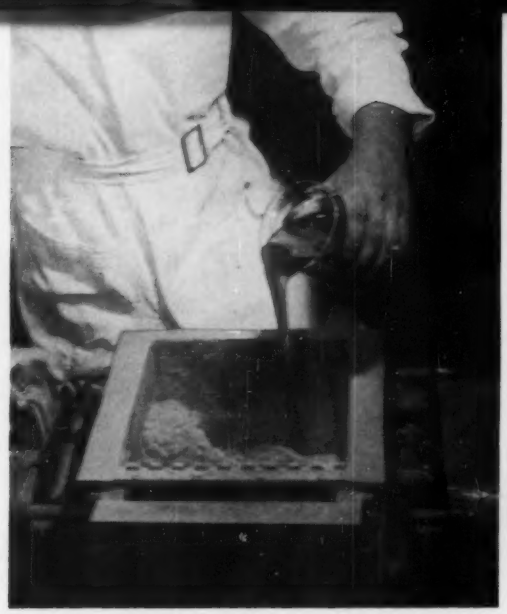


Typical premix ingredients are sisal reinforcement, liquid phenolic resin, calcium carbonate filler, zinc stearate lubricant, and nubian black pigment

Processing equipment

Various types of mixers can be used for the successful preparation of premix phenolic molding materials and many are presently being investigated. The most widely used mixer and the one utilized for the preparation of the impact material described in this article, is a jacketed, double-blade, rectangular, trough-type, kneader-mixer equipped with spiral or sigma blades. (Both types of blade are used successfully but the spiral blade is preferred because it imparts better mixing.) There should be a clearance between the blade edge and the shell of the mixer of at least ¼ in. to prevent blade jamming, but for best mixing action the blade clearance should not exceed ⅜ inch.

Blade speed should be 20 r.p.m. or higher, although a lower speed may be used with a longer mixing cycle. The mixer should be heated to speed the cure of the phenolic



Phenolic resin is added to dry-blended ingredients in a mixer of the type most commonly used for premixing. Note that in spite of high reactive content, resin flows freely. Mixer temperature is 200° F.

Premix of experimental, low-impact, cotton-flock-filled material is dumped from mixer. Batch has been mixed for 25 min. after phenolic resin was added

resin and to remove the water of condensation and other volatiles. Temperature of the mixer is based on the resin cure time and the mixing cycle desired; if a short-cure resin is exposed to high mixing temperatures, a very short mixing cycle would result that might not give the desired thoroughness of mixing.

Following is a tabulation of different-size mixers, their approximate cost, and the amount of premix material each mixer will produce, based on phenolic materials of high bulk density, about 2 lb./gal.

Working capacities	*Approximate cost*	*Batch size*
gal.	*$*	*lb.*
5	4,000	10
20	10,700	40
50	11,400	100
100	16,300	200
200	24,000	400
300	30,400	600
500	43,400	1000

Premix shown discharging from mixer in photo above, after being preformed and electronically preheated, is molded into auto pump impellers in four-cavity mold. Note smooth finish characteristic of cotton reinforcement and intricate details achieved with this free-flowing compound

Mixing technique

The heated kneader-type mixer performs three functions: it dry-blends the dry ingredients, mixes the resin and dry components into a mass, and advances the cure of the resin to a state suitable for molding.

Mixing schedule with approximate time for each step is as follows:

0-5 min.—heat mixer to 150 to 240° F. and blend all the dry ingredients (wood flour, "Silvacon," calcium carbonate, clay, lubricant, and color).

5-6 min.—add liquid resin (particular note should be made of the time of resin addition).

6-40 min.—allow materials to mix thoroughly.

30 min.—add glass, if included in formulation.

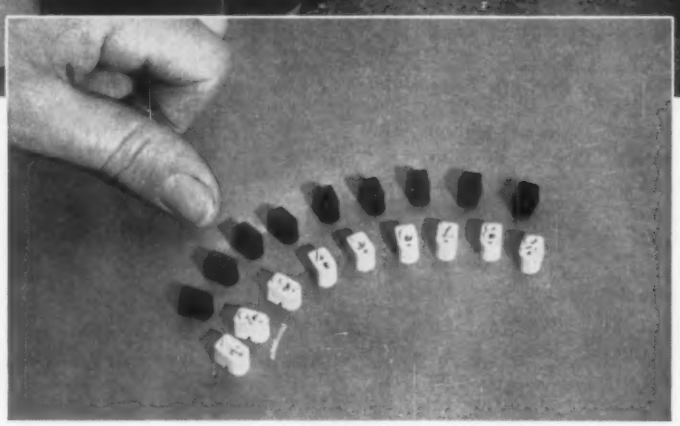
40 min.—dump material from mixer. (Dump time is predetermined and depends upon cure time of the resin, mixing temperature, and formulation).

Temperature is a most important variable and must be closely controlled throughout the entire mixing cycle. Temperatures ranging from 150 to 220° F. have been used, but each premix formulation must be checked for proper compounding temperature.

When the premix is dumped from the mixer, cure should be far enough advanced so that the material is in a state suitable for

(*To page* 140)

The Stokes Model 701 press installed in the Bristol, Va. plant of Monroe Calculating Machine Company. Operation is completely automatic . . . is unattended except for loading of the hopper and removal of finished parts.

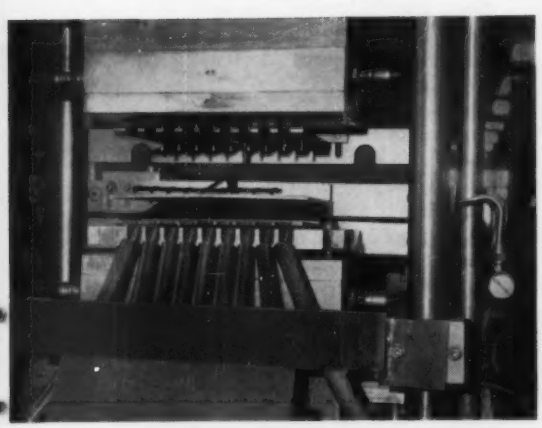


Nine separate pieces are produced at one time. These numerical inserts later have the flush facing molded around them—are used as keyboard buttons on calculating, adding, and accounting machines.

Monroe Calculating Company saves . . . with automatic molding, de-gating, sorting on Stokes 701 injection press

Monroe Calculating Machine Company, world famous for its quality machines and progressive engineering outlook, is ever on the alert for new, more advanced manufacturing methods. It discovered, in the Stokes 701, an improved and more economical method for molding numerical inserts for keyboard buttons.

The Company automatically molds and sorts the inserts . . . 9-at-a-time . . . at its Bristol, Va., plant. The Stokes 701 automatic injection machine operates virtually unattended . . . has provided a 13% increase in production, and has reduced man-hours by over 85%. As a result of this experience, Monroe has purchased 2 additional Stokes 701's . . . one for its Orange, N.J., plant, the other for Monroe-Holland in Amsterdam.



Close-up of the die table shows the sprue and runners about to be pushed down the slide (foreground) to the scrap barrel. The nine finished parts are funneled into nine separate bins via the tubes at the base of the die.

The Stokes Model 701 machine often economically replaces 4-ounce or larger machines since freedom from the labor factor allows the number of cavities in the die to be planned for optimum production requirements. It does not require special attachments or extra-cost gimmicks. The automatic features are integral. Its precisely repeated automatic cycles provide a higher degree of uniformity and quality of finished parts. The patented Stokes ejection system positively clears all parts and runners from the die. Secondary protection is provided by the use of the more common low-pressure close. The completely self-contained vertical design of the Stokes 701 saves floor space . . . permits easy attendance . . . and facilitates mold set-up.

Write for your copy of literature on the Stokes Model 701—the truly automatic 2-ounce injection molding press. Ask for a Stokes production analysis on your own parts.

Plastics Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

molding. The form of the reinforced material after dumping is dependent upon the temperature of the mixer and the formulation used. Through proper formulating of components and the use of low temperature, fairly uniform small granules can be prepared.

Recipe for impact premix

The following is a typical impact formulation:

Resin	
Liquid phenolic	25-35%
Fillers	
Wood flour, "Silvacon," calcium carbonate, and clay	45-60%
Reinforcement	
Sisal, glass fiber, cotton fabric, and cotton flock	5-20%
Lubricant	
Zinc stearate, calcium stearate, and stearic acid	0.5-2%
Color	
Nubian black, burnt umber, etc.	0.5-2%
Neutralizers	
Calcium hydroxide	0.5-1%

1) *Resin:* As is the case with standard phenolic molding materials, there are many different resins for specific applications. To date, only water-soluble, one-step resins have been evaluated and successfully field-tested by Barrett and it should be noted that molding materials prepared with this type resin will not satisfy certain specific applications. Special liquid resins will have to be developed for the premixing; work on these is in progress.

Principal function of the resin in any molding material is to flow through and fill out the mold cavity and to bond the fillers and reinforcement. Liquid resins having low viscosities at elevated temperatures are necessary to obtain adequate wetting out of the added components. But these resins must be high in content of reactive material, i.e., low in diluents, so as to minimize the amount of volatiles to be removed. Low-solids resins require extended (therefore inefficient) mixing cycles. To allow for adequate mixing time and necessary control, resins with stroke cures of over 40 sec. are required.

The properties of a typical water-soluble, one-step Barrett Plaskon premix resin are as follows:

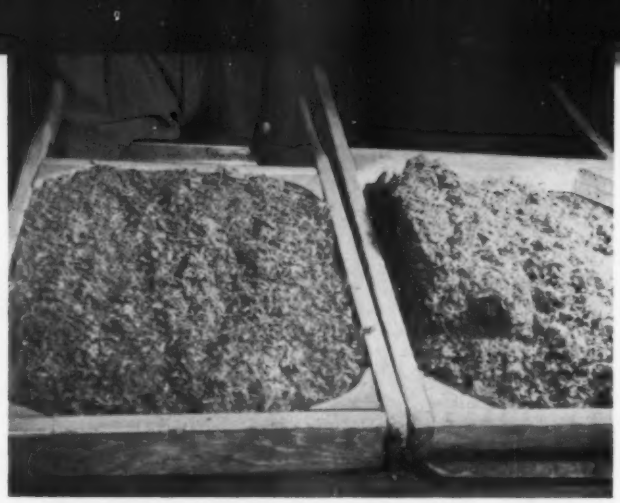
Reactive "solids" content, %	75.0
Viscosity, cp., 25° C.	2000.0
Stroke cure, 150° C., sec.	55.0
Set time, 135° C., sec.	490.0
pH:	7.6
Specific gravity	1.25

Phenolic materials prepared with a Barrett Plaskon premix resin exhibit a nominal shelf life of approximately 120 days; after this period they do not flow as well and they cure faster. However, even after six to nine months on the shelf, the premixes are completely moldable at high pressures.

2) *Fillers:* Various mineral and cellulosic fillers such as clay, limestone, mica, asbestos, wood flour, and "Silvacon" are used in phenolic molding compounds.

Wood flour is the most widely used of all phenolic fillers because of its low cost and low specific gravity, and because of the excellent strength of moldings containing it. Wood flour is available in various mesh ranges and types of wood although white pine of approximately 100 mesh is usually preferred.

"Silvacon," a bark derivative containing natural resinous material, is used as an extender to reduce the resin content and hence reduce final cost of the mix. This material imparts good flow to the molding compound but its acidic nature tends to retard the cure of the phenolic resin and



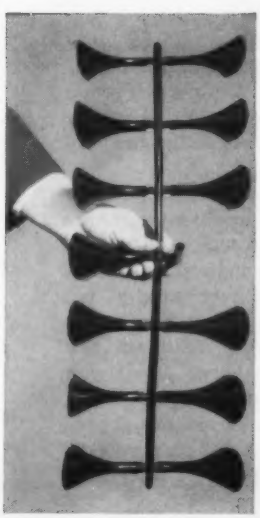
High-impact, cotton-flock-filled premix material in loading boards is relatively dry and coarse-textured and is too bulky to be preformed. It will be used in compression molding simple serving trays. (Subsequent operations are shown in photos on p. 142)

Table II: Typical premix-type impact material[a]

Powder properties	*Value*	*A.S.T.M. test method*
Form of material	¼-in. lumps	—
Bulk factor	4-4.5	D392-38
Apparent density	0.3-0.35	D392-38
Storage life	Good	—
Properties of molded material		
Flexural strength, p.s.i.	8000 avg.	D790-45T
Izod impact strength, ft.-lb./in. of notch	0.6 avg.	D256-47T
Water absorption, %	1.0 max.	D570-42
Shrinkage, in./in.	0.006 avg.	D955-48T
Specific gravity	1.40 avg.	D792-48T

[a]All specimens prepared by compression molding.

Returns drop sharply when heels are made of Tenite plastics



Heels molded of Tenite Acetate or Tenite Butyrate have exceptional toughness and a strength far exceeding that of heels made of wood. One manufacturer reports he has not received a single breakage return from 250,000 pairs of shoes shipped during the seven months he's been using heels of Tenite plastic.

The superior toughness of the Tenite plastics virtually eliminates breakage during manufacturing, wear, or lift replacement. Moreover, these plastics facilitate an excellent finish. Heels can be used "as molded," sprayed with lacquer, metallized, or covered with plastic, leather or fabric. Lacquers and adhesives that work very satisfactorily with the Tenite materials are readily available.

Tenite plastics improve the performance of products in many different fields. For information on these versatile materials, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE

ACETATE • BUTYRATE

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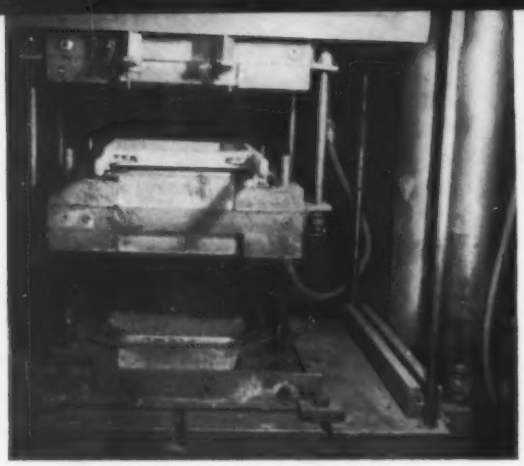
1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

Information regarding Tenite also can be obtained from local representatives listed under "Plastics—Tenite" in the classified telephone directories of these cities: Atlanta, Chicago, Cleveland, Dayton, Detroit, Houston, Kansas City, Leominster (Mass.), Los Angeles, New York City, Portland (Ore.), Rochester (N.Y.), St. Louis, San Francisco, Seattle and Toronto—elsewhere throughout the world, from Eastman Kodak Company affiliates and distributors.



Phenolic premix material on loading boards has been emptied into cavities of dual platen mold

Operator is taking newly molded tray from mold. In this non-positive mold, flash along the edges of the tray is indicative of complete filling out of the tray

Table III: Cost Analysis

	Premix impact material	*Standard impact material*
Specific gravity	1.40	1.40
Cost, ¢/lb.	19.3[a]	28-40
Density, lb./cu. in.	0.05	0.05
Cost, ¢/cu. in.	0.72	1.4

[a]Sum of raw material cost and an estimated 5¢/lb. production cost.

it must be neutralized with calcium hydroxide.

Limestone has a low oil-absorption value, so its premix compounds require less resin; since it is white, it also imparts improved surface finish and offers a background for colors.

3) *Reinforcement:* Chopped glass, sisal, and cotton fabric and flock are the most widely used reinforcing materials. Glass fiber, because of its high cost, is only used when exceptional strength is needed. Phenolic molding materials containing glass fiber require extra care and special handling because the bundles of glass filaments that make up chopped fiber disintegrate and lose their reinforcing ability if worked excessively.

Sisal fibers impart good impact strength. This material has a high affinity for water; thus, compounds requiring good water resistance should not be formulated with sisal. On a weight/cost basis, sisal delivers the highest impact strength of any material now on the market. Parts molded from sisal-filled compounds, however, have a characteristic orange-peel surface precluding some applications.

Cotton fabric or flock materials impart good finish and good water absorption properties to the molded part. They only impart half the impact strength of sisal, however, and require more resin.

4) *Lubricants:* Lubricants such as metallic stearates and low-molecular-weight polyethylene are commonly used with phenolic premix materials to aid in processing and to assist the removal of the part from the mold.

5) *Color:* Generally, phenolics have poor color properties and will fade when exposed to light. Molding materials are limited in color to black, brown, and other dark (red and green) shades. Various dyes or pigments can be used with phenolics. Light colors can be molded, if their impermanence is not objectionable.

Flash is easily removed to yield finished trays with high gloss and smooth edges

Molding equipment

Standard compression molding presses are satisfactory for phenolic premix materials. The basic molding problem is to compress the material into the desired shape and hold it under pressure and heat (300 to 350° F.) until the chemical action which results in hardening takes place. Premix materials, like standard phenolics, require pressures in the range of 2000 to 3000 p.s.i.

Phenolic molded parts usually do not require cooling jigs. Large parts with thin wall sections are, however, comparatively weak and will distort or warp if not mounted on a cooling jig.

The standard finishing and trimming operations used with standard phenolics are also used for premix materials, but premix materials filled with glass will require special handling because of their high abrasive action.

Design and fabrication with

Directionally reinforced plastics—II

*By A. L. Donaldson and R. B. Velleu**

Fabricating reinforced plastics for a given end-product is a production area concerning which a considerable body of knowledge has been accumulated in the last few years, but certain problems still present themselves. One of the most formidable of these is the fact that because the processing of ordinary reinforced plastics laminates generally requires an appreciable amount of hand layup, the associated human variables are found to produce a highly variable product. This has been overcome in the case of Minnesota Mining and Mfg. Co.'s Scotchply brand reinforced plastic which is mechanically processed under carefully controlled conditions. This material comes in several types and is designed for mass production of reinforced plastics parts.

In type 1002, this high-strength reinforced plastic is a moldable epoxy-glass laminate designed for production cure cycles. Its thermosetting resin is reinforced with continuous, non-woven glass filaments at a constant resin-to-glass ratio of from 35 to 65 percent. It can be supplied, uncured, in roll or sheet form. Standard filament orientations are unidirectional, crossplied, or isotropic. Molded thickness of one ply is 9 mils.

Molding

As described here, the material is intended primarily for compression molding. It is readily formed into shapes requiring mild draws—trays, turbine blades, etc. —where the change in cross section during molding is 20% or less. Because of the resistance of the glass reinforcement to stretching, these materials are not recommended for deep-draw moldings or for shapes having compound curvatures. After forming, the piece is hardened or cured merely by heat and light pressure. No further chemical treatment is required. Since forming is done before curing, molding forces are small.

Layup should be done at room temperature, or slightly higher. The multi-directional laminates offered are laid up mechanically by a laminating machine; or, if the user wishes, he can do his own layup by hand.

Thin sheets of the material may be trimmed or cut to any desired shape by razor blade or scissors. A linoleum knife, rubber mill knife, or similar instrument can be used on sheets up to ⅛ in. in thickness. Heavier pieces require shearing, bandsawing, or—preferably—cutting with a portable hacksaw with a scallop-edged blade similar to that of a bread knife. These blades may be kept clean by frequent wiping with a cloth saturated with acetone or a similar solvent.

The protective paper liner guarding the uncured sheets and tape from foreign matter must be stripped off prior to molding. A corner edge should first be started; then a series of sharp pulls will quickly remove the liner. Because "tackiness" increases with temperature rise, it is best to remove—or at least begin to remove—the liner at room temperature.

Mold preparation requires, first, that the mold surface be clean and dry; second, that one of a variety of release agents for epoxy materials be applied. Especially recommended are Dow Corning's DC-20 and Ram Chemical Corp.'s Garan #225. One drawback to the Dow Corning silicone is that it prevents adhesion of paint or print to the finished molding. If the piece is to be painted, the silicone film must first be washed off. However, the required roughening of the surface of the part in preparation

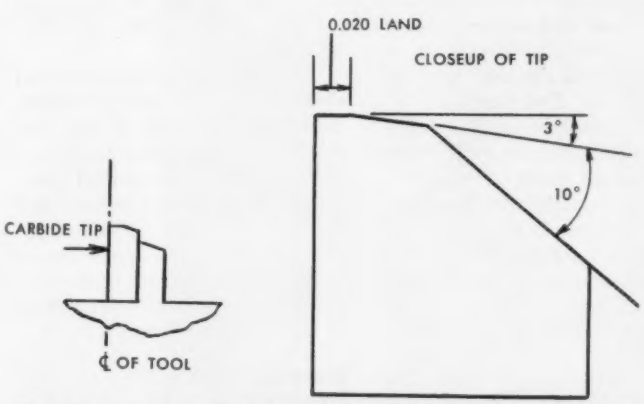


Fig. 1: Recommended shape of tooth of shell end mill to be used in milling glass-reinforced epoxies. The zero rake angle is used on all machine tools for these materials. Solid carbide end mills can be used as manufactured

*Technical service manager and applications engineering group supervisor, respectively, Reinforced Plastics Div., Minnesota Mining and Manufacturing Co., St. Paul, Minn.

for painting will effectively get rid of the silicone. As a result, the Garan #225 has proved to be the best and least expensive all-round product for this use.

The release should be applied liberally to insure a continuous film. On new molds and porous surfaces, the release should be allowed to air-dry, and as many applications used as necessary to build up a continuous surface film; viewing in light will show "oil slick" when this is achieved. The release should then be precured at 300° F. for several hours, if possible; an overnight cure or longer is desirable, especially on molds that have not been broken in previously. To renew the release, a new coat is simply wiped on without curing, and allowed to air-dry before molding. To determine release characteristics with any combination of mold surface, release agent, and molding stock, it is recommended that only a small section of the total area be molded on the first attempt.

It is suggested that a trial molding of a flat panel be made prior to the actual piece to acquaint the molder with the handling characteristics of the material. The intended mold material, surface preparation, temperature, pressure, and molding cycle should be duplicated as closely as possible.

This trial molding may also serve to determine the correct "gel" time. "Gel period" is the liquid-resin phase the material goes through when forming heat is applied. A minimum of pressure is necessary to force out any entrapped air and densify the molding during gel. However, a slight resin flow is required to insure a good molding. The length of time of this gel period may range from 0 to 90 sec. for a ⅛ in. thick panel of type 1002 reinforced plastic.

With an open or non-restrictive mold, pressure applied before gelling may cause excessive resin flow-out and disruption of the filament pattern; if pressure is applied too late, the result will usually be a molding with poor density and surfaces.

With a closed mold, where little or no resin flow is possible, full pressure can be applied almost immediately after forming. However, it is usually desirable to use some form of venting in order to permit the escape of entrapped air and to let slight resin flow take place.

Determination of the correct gel time under the existing conditions may be made on the first molding by alternately increasing and decreasing the applied pressure. The gel period is over and the material ready for full molding pressure when there ceases to be a resin flow-out or there is no indicated "fall-off" of pressure on the pressure gage.

Table I: Cure cycles of type 1002 "Scotchply" reinforced plastic

Thickness	Cure cycle No. 1[a] (press and postcure) Press time at 330° F.	Cure cycle No. 1[a] (press and postcure) Oven postcure at 280° F.	Cure cycle No. 2[a] (press only) Press time at 330° F.
in.	min.	hr.	min.
⅛	5	16	35
¼	10	16	40
½	15	16	45
1	25	16	55

[a] Both cycles produce mechanical properties as listed in Technical Data Sheet No. 2, Sept. 1, 1956, on "Scotchply" reinforced plastic. With the elimination of the oven postcure in cycle No. 1, however, room-temperature mechanical properties will be 85% of those values listed. It is also possible to cure type 1002 laminates by high-frequency, dielectric-loss heating, but firm cycles have not yet been established.

Molding steps

The following steps should be taken in molding:

1) After the protective liner has been removed from the laminate, insert sheet between the heated mold faces.

2) Form by closing the mold as rapidly as the gel period and thermoplasticity of the sheet will permit.

3) Hold at contact pressure during the gel period, and increase to full molding pressure of 25 to 100 p.s.i. after gelling.

4) Cure according to Table I, below.

Aluminum molds are good for short- and medium-length runs, and steel for long runs. In making prototypes, experimental molds of an epoxy tooling material have been used with good success for runs of 10 to 20 parts. (See MODERN PLASTICS Encyclopedia Issue, 1957, p. 743, for detailed information concerning epoxy tooling for molding.)

Machining

Properly molded, the reinforced plastic under discussion has a uniform density which lends itself to all common machining and finishing operations. Due to the unique nature of the material, however, certain general practices should be observed:

1) The hardness and abrasive character of the fibrous glass reinforcement requires that well sharpened, carbide-tipped or diamond tools be used. Tools should be ground as shown in Fig. 1, p. 143. A high speed with a slow feed generally produces the best cut.

2) Since the laminates are poor conductors of heat, care should be taken to avoid excessive heat buildup at the working point. Air-, vapor-, or water-cooling will aid heat dissipation both from the tool and the material, as well as help to dissipate the dust.

3) Dust caused by some of the machining operations is irritating to many persons and abrasive to equipment. It can be vented or collected by any of a number of methods. One objection to the use of water-dissipation is that the dust, rather than being removed, frequently has a tendency to cake down instead.

In general, considering the formability of the material before curing, the end-product design

(*To page* 264)

New test of sheet formability

Up to now, no satisfactory method of measuring the formability of thermoplastic sheets has been available. The instrument and method described here are capable of measuring the maximum areal elongation of any formable sheet at any temperature in its forming range, at a stretching rate typical of commercial forming. The resulting plot of areal elongation versus temperature will help plastics designers to judge the practicability of forming any particular piece, while sheet formers will be able to choose the most economical operating conditions at which the elongation required for a given part can be accomplished.

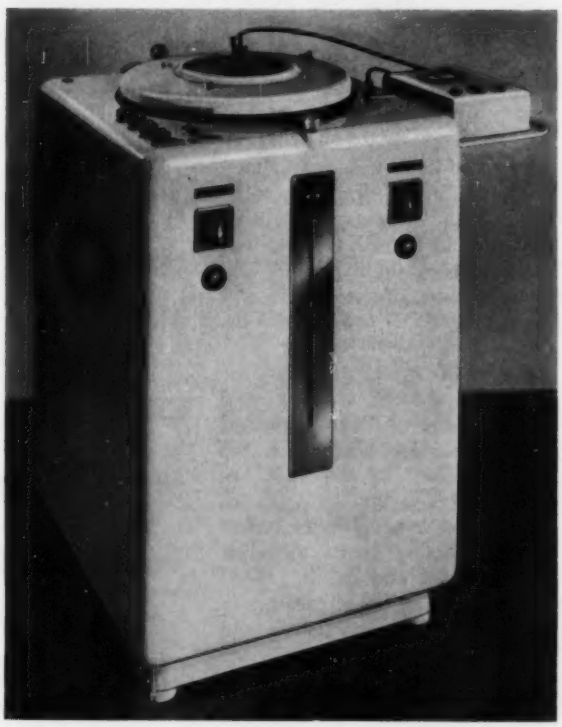
Sheet thermoforming is probably the leading method of producing plastics articles having thin, uniform sections, yet almost no quantitative information is available on the formability of the many sheet materials offered to thermoformers. As a result, it is impossible to estimate reliably what gage sheet will be needed in forming a proposed product, or even whether it is formable from any given sheet (unless very little stretching is required or the design closely resembles one that has already been successfully tried).

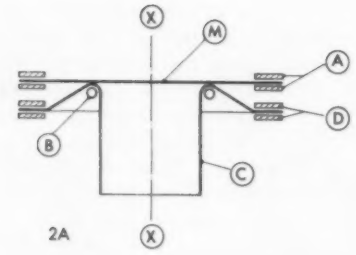
Much time and material is lost in hunting for a combination of conditions under which a new product may be satisfactorily formed. Even the money spent on tooling may be lost if the hunter fails to find his quarry. For many forming jobs, the combination thus found may be only one of many possible ones, and it is not likely to be the one giving the greatest economy.

In the eyes of the sheet former, the most important question to be answered about the sheet is: how much will it stretch without tearing? Tensile elongation figures listed in standard properties charts do not begin to answer this question, since the values listed there are obtained at room temperature, at low stretching rates, with tension applied in a single direction. The sheet thermoformer needs to know stretchability under forming conditions, i.e., at temperatures ranging from 175 to 300° F. and higher, with biaxial stretching, at very high stretching rates. Ideally, for each sheet material that he must use, he should have a chart showing the maximum areal elongation of the sheet versus temperature, measured at stretching rates typical of commercial forming operations. The Formvac[1] Sheet Tester, developed over the period 1954-7 by a cooperative effort of the Siatem Co., Padua, Italy, and the staff of the University of Padua, can generate just this kind of information.[2] Figure 1, below, is a photo of the Sheet Tester as it appears while a test is in progress. The tester may be used at sheet temperatures up to 200° C. (392° F.) and theoretically can draw down the test area by over

[1]The name Formvac designates the sheet forming equipment of Hydro-Chemie, Ltd. P.O. Box 22, Zurich, Switzerland.
[2]The Formvac Sheet Tester is the subject of Italian patent No. 41165 and of patents pending in other countries.

Fig. 1: Formvac Sheet Tester in operating position. Vertical scale in front of machine is preset with knob directly above to amount of stretch desired in sheet. (Illustrations, Hydro-Chemie, Ltd.)





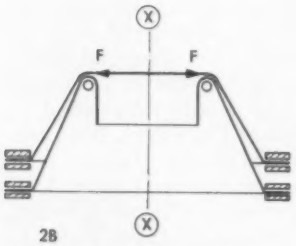


Fig. 2: Diagram showing operating principle of sheet tester. Sample *M* is stretched more and more over ring *B* by the downward movement of clamping flanges *A* and friction bag *C*

500 fold. All but thickest sheets can be tested; a modification may soon take care of these.

How sheet is stretched

In this new sheet tester, the heat-softened thermoplastic sheet is subjected to rapid, uniform areal elongation by the method illustrated in the diagrams of Fig. 2, above. The test specimen *M* is shown in Fig. 2A clamped between two flanges *A* and located above an annular frame *B* over which a bag *C*, made of inelastic raw silk, is draped and secured at its edge by the flanges *D*. The annular frame *B* is stationary, but flanges *A* and *D* can travel vertically along the X-X axis.

Figure 2B shows what happens when the sheet is heat-softened and flanges *A* and *D* are traversed downward. The section of the sheet enclosed by the ring has been stretched uniformly in all radial directions by symmetrical forces *F* acting across the ring. As the sheet and the bag bend over the ring, the woven silk meshes into the hot plastic and assures that the material in the ring is stretched without slipping. Because the bag furnishes some of the pull on the sheet, the stretching forces on the areas outside the ring are less than the inside forces *F*, so the greatest elongation occurs on the circular area inside the ring.

Operating procedure

The diagrams of Fig. 3, below, show the sequence of operations in making a sheet-elongation test. As in Fig. 2, the sample is clamped by flanges *A* and the silk bag is draped over the hollow ring *B*, through which cold water may be circulated under the control of a magnetically operated valve. The retractable main radiant heater G_1, whose under surface is insulated, is swung into position to heat the specimen to the desired temperature under the control of the specially designed thermocouple *H* that lightly touches the upper, unheated side of the sample. When the test temperature is attained, the signal from *H* automatically retracts heater G_1 and starts the stretching process. The counterweight *E* keeps the silk bag taut as stretching proceeds. The smaller heater G_2 maintains the temperature of the sheet after the main heater has been retracted.

Procedure is as follows:

1) The test sheet is positioned on the lower clamp frame, visible in Fig. 4, p. 148, and the upper clamp is firmly screwed down.

2) The lid of the tester is closed and the thermocouple carefully positioned over the sheet.

3) Test temperature is preset on the stretch-starting device.

4) After the heater has warmed up for a few minutes, it is swung into place beneath the sheet

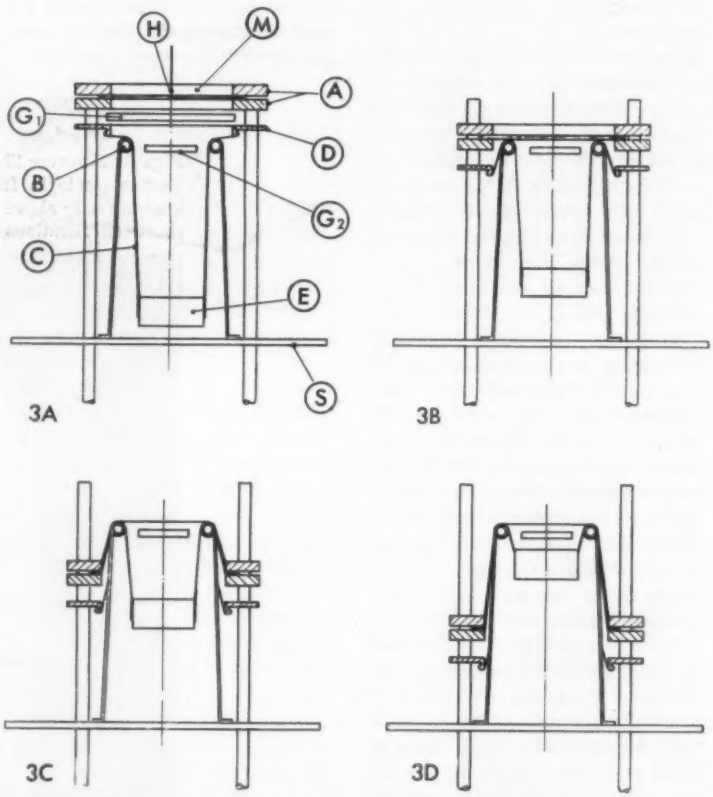
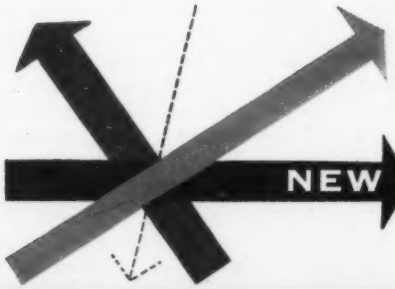


Fig. 3: Successive stages in testing elongation of formable sheet. 3A) Sheet *M* is heated; 3B) heater is withdrawn and stretching begins as clamping ring *A* and friction bag ring *D* move downward; 3C) stretching continues, with greatest elongation occurring in center section of sheet; 3D) flanges *A* and *D* have descended full preset distance and stretching is complete. Overstretched sheet will rupture inside ring



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where it stays until the sheet reaches the preset temperature, when it swings out.

5) Stretching starts as flanges *A* and *D* (Fig. 3) move downward at a rate of 2.68 in./sec., under the control of the drive mechanism shown in Fig. 5, below. This downward rate corresponds to an areal elongation rate of about 175%/sec. By means of the round knob at the front edge of the top of the machine (Fig. 4), the distance that *A* and *D* travel —i.e., the amount of stretch—can be regulated. A pointer that moves along the graduated scale on the front face of the machine indicates the distance. The amount of stretch is reduced gradually in successive tests until the stretch distance is just short of that required to rupture the sheet. Figure 6, p. 150, shows a typical case where, if the downward travel of *A* and *D* had been set at only 1 mm. more, the sheet would have ruptured within the ring.

6) The instant the stretching process is completed, a valve opens to admit cooling water to the ring *B*. This freezes the rim of the test sheet immediately, preventing its contraction.

7) *A* and *D* are raised by a pushbutton control, the clamp frame is opened, and the stretched piece removed (Fig. 7, p. 150).

8) The section that had been within the ring is cut out with scissors and its thickness gaged with a sensitive micrometer. This thickness is divided into the original thickness of the sheet and the quotient multiplied by 100 to get the precentage areal elongation at that temperature.

Usually five to ten trials are made before the amount of stretch just short of rupture is accurately determined. Additional trials should be made at the end point and the several values of elongation averaged to get the final value for that temperature.

To accommodate a range of sheet thicknesses, the primary and auxiliary heaters may be set at any one of four heats, low for the thinnest gages and on up to high for the thickest.

When testing at one temperature is completed, the elongation-temperature spectrum is obtained by repeating the test procedure at other temperatures. Usually temperature steps of about 10° C. (or 20° F.) will be adequate to obtain a good curve. A sample spectrum, for an unpigmented, high-impact polystyrene sheet, is shown in Fig. 8, p. 150.

Fig. 4: Top view of tester with top open and with upper clamping ring in up position. Note thermocouple probe visible in center of lid window

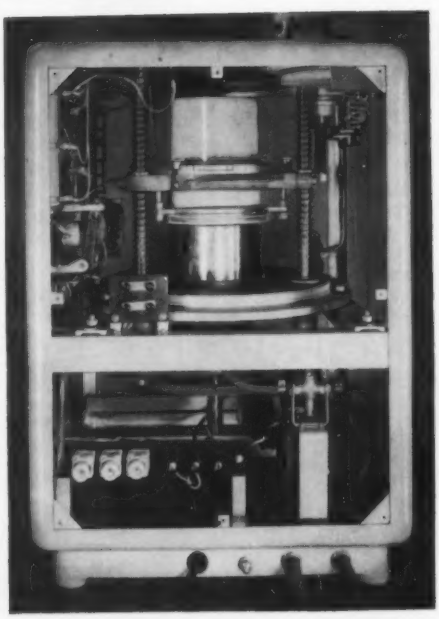

Fig. 5: Cover panels have been removed from machine to show driving mechanism for downward-moving flanges, here in mid-stretch position

Remarks

The maker of the sheet tester recommends that the entire procedure be repeated at each temperature for other thicknesses of sheet and the results averaged. However, the editor of this department believes that, because of the manner in which the sheet is heated and the temperature measured, closely simulating commercial practices, the temperature distribution through the sheet will vary with sheet thickness. That being the case, it is to be expected that the test results will show up real differences in the maximum elongations of thin and thick sheets of the same composition. It would therefore be misleading to average the values for sheets of different thickness.

One might question the value

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Fig. 6: Test sample at end of stretch cycle. Previous runs indicated that if edges of this sample had been pulled down 1 mm. more, it would have ruptured

Fig. 7: Chilled sample is unclamped and removed from tester. Center section is cut out with scissors and its thickness measured

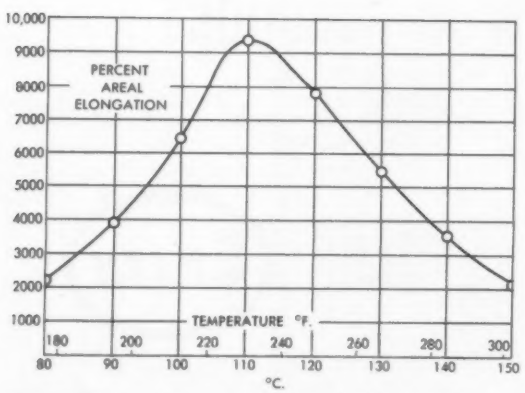


Fig. 8: Elongation spectrum for a highly stretchable, high-impact polystyrene sheet. Each point represents results of a dozen or more test runs

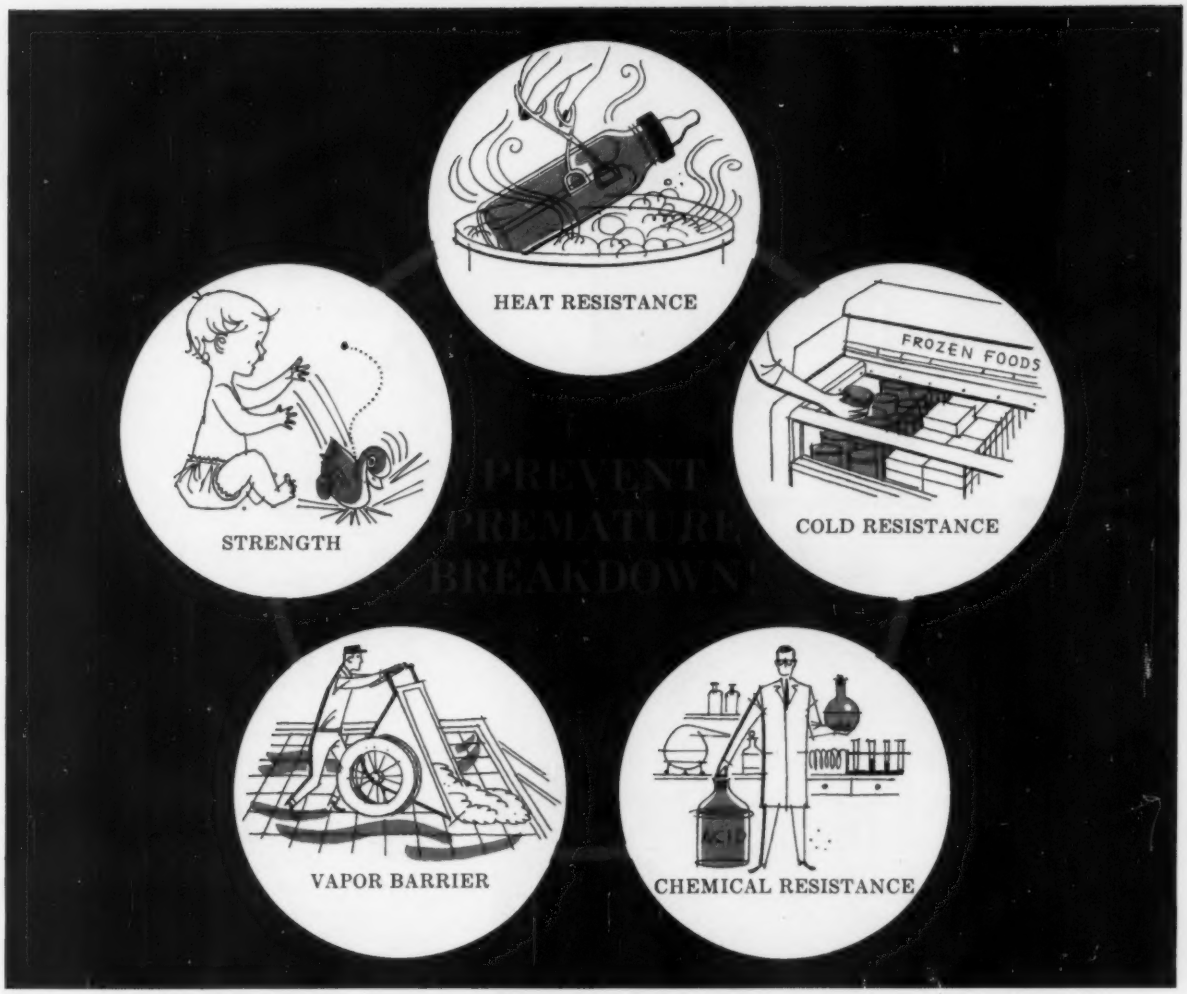
of testing the elongation of the material of Fig. 8 at temperatures above 110° C. (230° F.) because any elongation possible at higher temperatures may be obtained also at some lower temperature. For example, 5000% elongation can be obtained either at 95 or at 132° C. However, the sheet tension involved is not the same, the sheet being much less strong and less viscous at the higher temperature. Thus, if one intended to drape form the material, a better product might be obtained at the higher temperature, albeit at some extra expense in heat and cycle time.

There is also another way in which the high-temperature data may be useful: some formable sheets are laminates of two or more different materials. For example, Mylar polyester film has been laminated to impact styrene sheet and subsequently formed. Where the forming temperature ranges of the laminate components differ, as do these two, the optimum temperature for maximum formability of the laminate can be determined only if the complete formability-temperature curve is available for the lower-softening material. Of course, even better would be a direct determination of the spectrum of the laminate itself.

Useful to sheet supplier, too

Additives such as pigments, plasticizers, and fillers are known to influence sheet formability (as well as the properties of the formed products). The sheet tester provides a tool for determining quantitatively just how important such effects are, making it possible for compounders to formulate sheet materials to best economic advantage for any particular application. Refrigerator parts provide a practical example: the deeply drawn food liner will generally require a material with good areal elongation properties, while many inner door liners could probably be formed from less costly filled sheet.

This test method for sheet formability is already under consideration by Committee D-20 of the A.S.T.M., whose chief duty is the development of tests and specifications for plastics.



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Forming sharper, thicker corners

By subdividing the plug in plug-ring-forming, corners can be formed first and chilled, thus distributing elongation more uniformly over piece

*By O. L. Pierson**

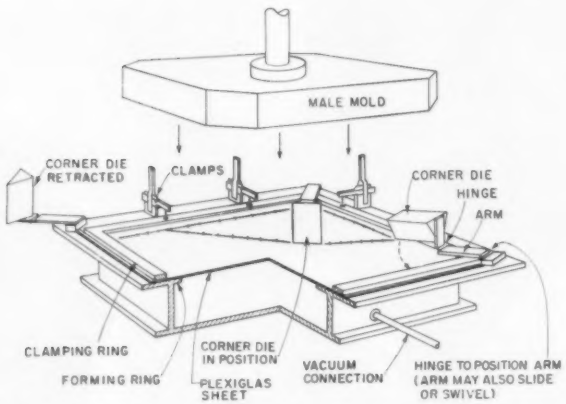

Fig. 1: Standard plug-and-ring equipment can be modified to produce improved corners by mounting retractable male dies at each corner and removing corners from the male mold so it can be inserted into the ring when corner dies are in place. (Illustrations, Rohm & Haas Co.)

Fig. 2: First step in forming process is to clamp edges of hot acrylic sheet around the edges of the ring. Corner molds must be retracted out of the way for this operation

A modified deep-drawing method forms substantially stronger and sharper corners in acrylic sheet, and may also permit forming corners in sheets thinner than has heretofore been practical.

One of the difficulties of forming sheet plastic by the conventional plug-and-ring method has been the relative fragility of the sides, and particularly the corners, of the finished part. With this method most of the stretch occurs in the corners and sides, so that these areas are much thinner and weaker than the remainder of the part. To obtain adequate thickness in these stretched areas, the fabricator must start with a sheet so thick that little-stretched areas end up much thicker than they need to be. Deep draw and sharp corners, though possible, have therefore been very wasteful of material and expensive to produce.

By the new technique described here, corners are formed from plastic which is gathered in from the bottom as well as the sides of the piece. With experimental, manual equipment it has been possible to form 29- by 29-in. pans, 4 in. deep, from ¼-in.-thick cast acrylic sheet, with corners 25 to 90% thicker than those obtainable with conventional stretch-forming methods. In addition, the thickness is more nearly uniform throughout the part.

Equipment

As illustrated in Fig. 1, above, the key to the method is a set of corner-forming molds which supplement the action of the male mold. These molds, which are right isosceles triangles in cross

*Plastics Fabrication Laboratory, Rohm & Haas Co., Bristol, Pa.

section, form the corners by pivoting down into the thermoplastic sheet and, completing a 90° arc, pushing the plastic into the corners of the forming ring. In traversing the arc-shaped path, the corner molds pull material from the center of the sheet. Hence far less stretch and thinning occurs in the immediate corner areas.

The right-angled corner molds should be made of a reasonably good thermal conductor (the ones shown in Fig. 2, p. 152, are steel angle irons), so as to cool the acrylic immediately on contact. In this way, as soon as the corner section is formed it loses some of its plasticity. Therefore, as the mold completes its arc, most of the stretching action occurs in the center part of the sheet which is still relatively warm and mobile. The induced cooling of the corner sections is another factor which minimizes thinning.

Any conventional plug-and-ring set-up, with or without vacuum assist, can be adapted to this method. Aside from the installation of the corner molds, the only other major modification required is in the male plug, from which the corners must be removed so that the plug can be seated when the corner molds are in position.

While optimum dimensions may vary with different equipment, the author has obtained best results with the sides of the corner mold equal to 15% of the length of the sides of the ring mold. The optimum sharpness of the corner will depend on the design of the part being formed.

The corner molds shown in Fig. 1 are mounted on a hinged arm, so that they can be swung out of the way while the Plexiglas sheet is being clamped down and while the finished part is being removed. Other methods of retraction may be equally practical. For example, the arm could be mounted on a slide or on a swivel.

Procedure

The following procedure is used at the Fabrication Laboratory for forming deep-drawn corners:

1) Clamp the hot Plexiglas sheet in position on the vacuum

(*To page* 270)

Fig. 3: Corners are formed by pivoting the four corner molds simultaneously down into the acrylic sheet until they rest against the corners of the ring

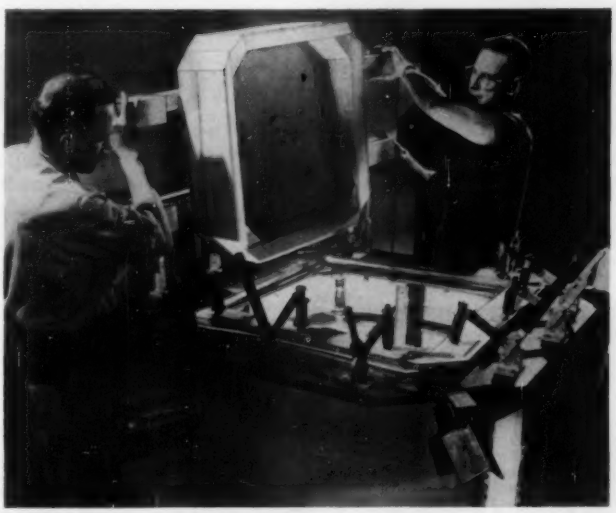

Fig. 4: Male mold is inserted into cavity after corner molds are in place. (To show construction and mounting arrangement corner molds are retracted in photo)

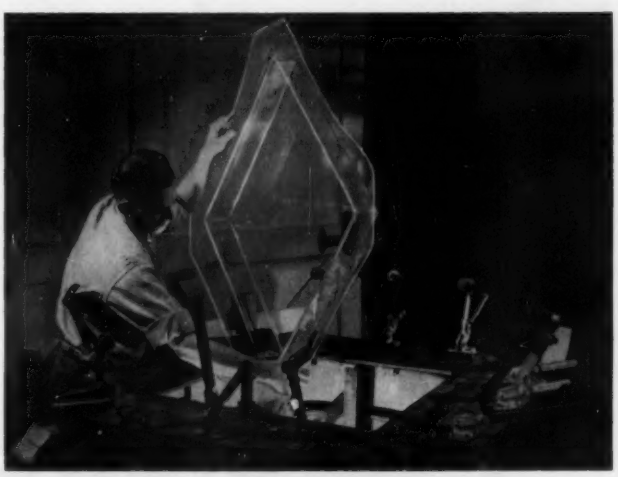

Fig. 5: After plastic material has cooled to below forming temperature, molds are retracted and formed part unclamped and removed for trimming

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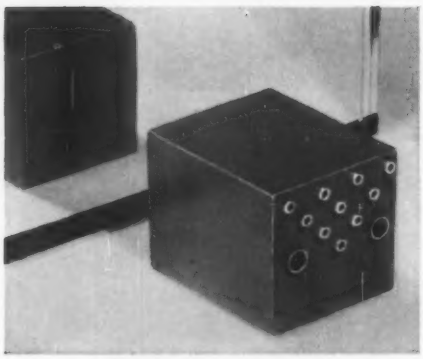

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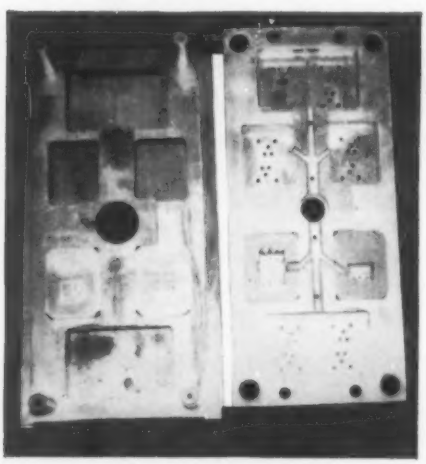

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Designing polymers for use as plastics

By Frank C. McGrew†

In a business as dynamic as the plastics business, it seems appropriate to consider technical work from the point of view of the development sequence involved in establishing new or improved materials commercially. This sequence often starts with a chemist's discovery of a new polymeric material or of a way to make a distinct change in the structure of a known type. The first thing the chemist learns is that a new polymer doesn't automatically mean he has a new plastic. Even if he has something with inherently useful properties, there is much to be done to provide the complete array of properties that furnish the basis for commercial success.

Fortunately, there are a great many ways in which the chemist can manipulate the composition of polymeric materials to change the resulting physical and chemical properties in intentional ways —this is a basic characteristic of high-polymer chemistry—and such changes *can* help convert a polymeric material into a plastic provided that the properties modified or corrected are properly chosen with utility of the material in mind.

In choosing the properties to be produced in the material, the first requirement is that the material can be fabricated by a practical process. This fabrication requirement is placed first because of its intimate relationship with the central theme of the plastics business—physical shape. Unlike polymeric materials used in textile-finishing resins, coating compositions, etc., plastics in general have utility in their final form only because they possess a certain definite physical shape, and only so long as they retain that shape within certain tolerances.

Generally speaking, it is the job of the plastics processor to work the plastic material into a more or less final shape. Accordingly, the response of processors to a new material is the first source of guidance on the adjustment of properties toward the commercial optimum. It is well known, however, that the "feedback" doesn't end there, for the performance of the processed material—be it molded, extruded, or

INFLUENCE	TYPICAL PLASTIC PROPERTY TESTED
STRESS IN FLEXURE, TENSION, SHEAR	MODULUS AND STRENGTH IN FLEXURE, TENSION, SHEAR
STRESS OVER VERY SHORT TIMES (TOUGHNESS)	(IMPACT STRENGTH (HIGH SPEED STRESS-STRAIN
STRESS OVER LONG TIMES	(CREEP (STRESS RELAXATION (ENVIRONMENTAL STRESS CRACKING
STRESS AT ELEVATED TEMPERATURE	(HIGH-TEMPERATURE STIFFNESS (HEAT-DISTORTION TEMPERATURE
STRESS OVER LONG TIME AT ELEVATED TEMPERATURE	HIGH-TEMPERATURE CREEP
STRESS AT LOW TEMPERATURE	BRITTLENESS TEMPERATURE
CYCLIC STRESSING	FATIGUE-ENDURANCE LIMIT
HEAT	(VICAT TEMPERATURE (COEFFICIENT OF THERMAL EXPANSION (CHEMICAL DETERIORATION
MOISTURE	(CHANGE IN DIMENSION (CHANGE IN MODULI

Fig. 1: Main enemies of shape of plastics pieces

*Reg. U.S. Pat. Off.

†Assistant Research Director, Polychemicals Dept., E. I. du Pont de Nemours & Co., Inc. This paper was presented at a meeting of the Newark S.P.E. Section, February 1957. No. 5 in a series on Synthetic High Polymers.

laminated—in the hands of the end user guides the processor, and through him the materials manufacturer, in further adjustment of materials characteristics to get the most service in the final use. Value to the end user depends on how well the processor has done his job in addition to how well the composition he uses was developed by the materials manufacturer, or, in terms of the title of this paper, how well designed the polymer is for use as a plastic. This discussion therefore seeks to describe the way in which knowledge of the processors' problems and knowledge of end-users' needs can be translated into advances in materials.

Stresses on plastic parts

Formidable influences are working in most applications to distort or damage beyond the point of usefulness the physical shape of the plastic piece given it by the processor (Fig. 1, p. 155). To begin with, there may be a distorting force, which can be applied in flexure (as in a wastebasket), in tension (as in wire coatings), or in shear (as in moldings with metal inserts). These requirements are so familiar that it is almost universally recognized as desirable to characterize a plastic product in terms of its response, either temporary (modulus) or permanent (strength) to stresses applied in flexure, tension, and shear.

These refer to stresses applied gradually and in ordinary environments. But stress is sometimes applied very abruptly and this puts a premium on the property known as impact strength, or referred to even more vaguely as toughness. In uses such as pipe, stress must be withstood over very long periods of time without much change in shape; to get a line on the ability of the material to serve in such situations, we measure yield strength and creep. In many uses, such as automobile hardware, the temperature to which a piece can be heated before it loses its ability to withstand stress is the important factor. And so high-temperature stiffness and heat-distortion temperature are a regular part of our characterization of plastics materials. The remainder of this list of stresses and environmental influences occur in some services as the important factors governing the utility of a plastic material in ultimate use as a shaped piece. Indeed the list could be considerably extended to include degradation by light, by solvents, etc., for in a business as varied in nature as the plastics business, there appears to be no kind of exposure condition or set of property requirements that is not called for in some end use or other. Nevertheless, the properties mentioned are the important ones so far as retention of useful shape is concerned.

The problem of designing mole-

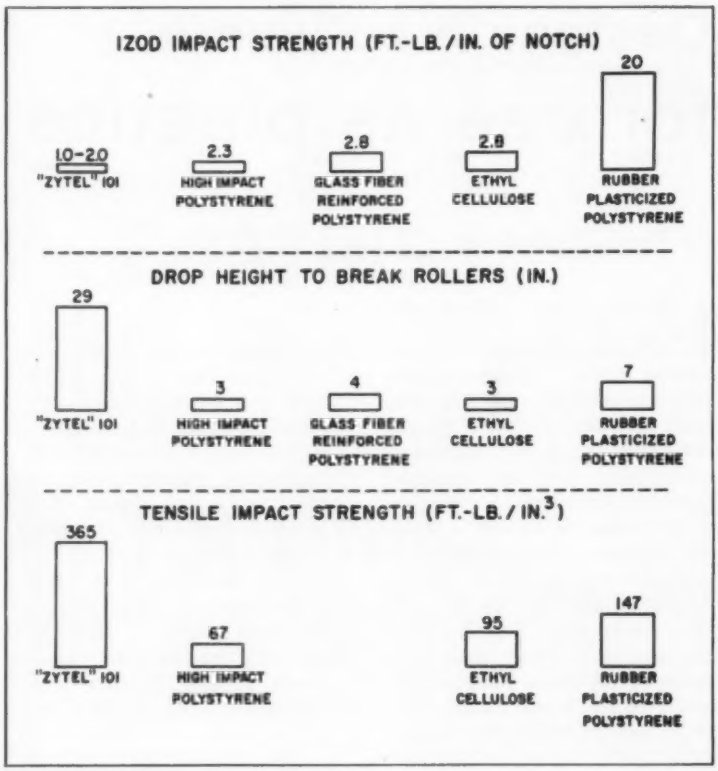

Fig. 2: Correlation of impact tests with toughness of door-latch rollers

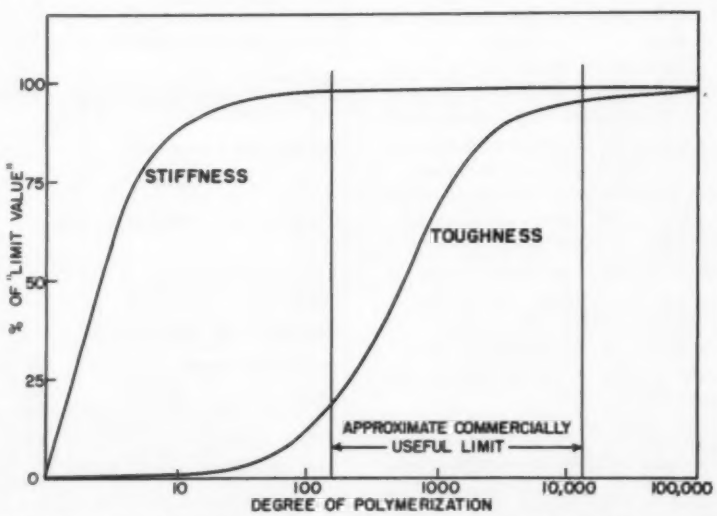

Fig. 3: Dependence of engineering properties upon molecular size

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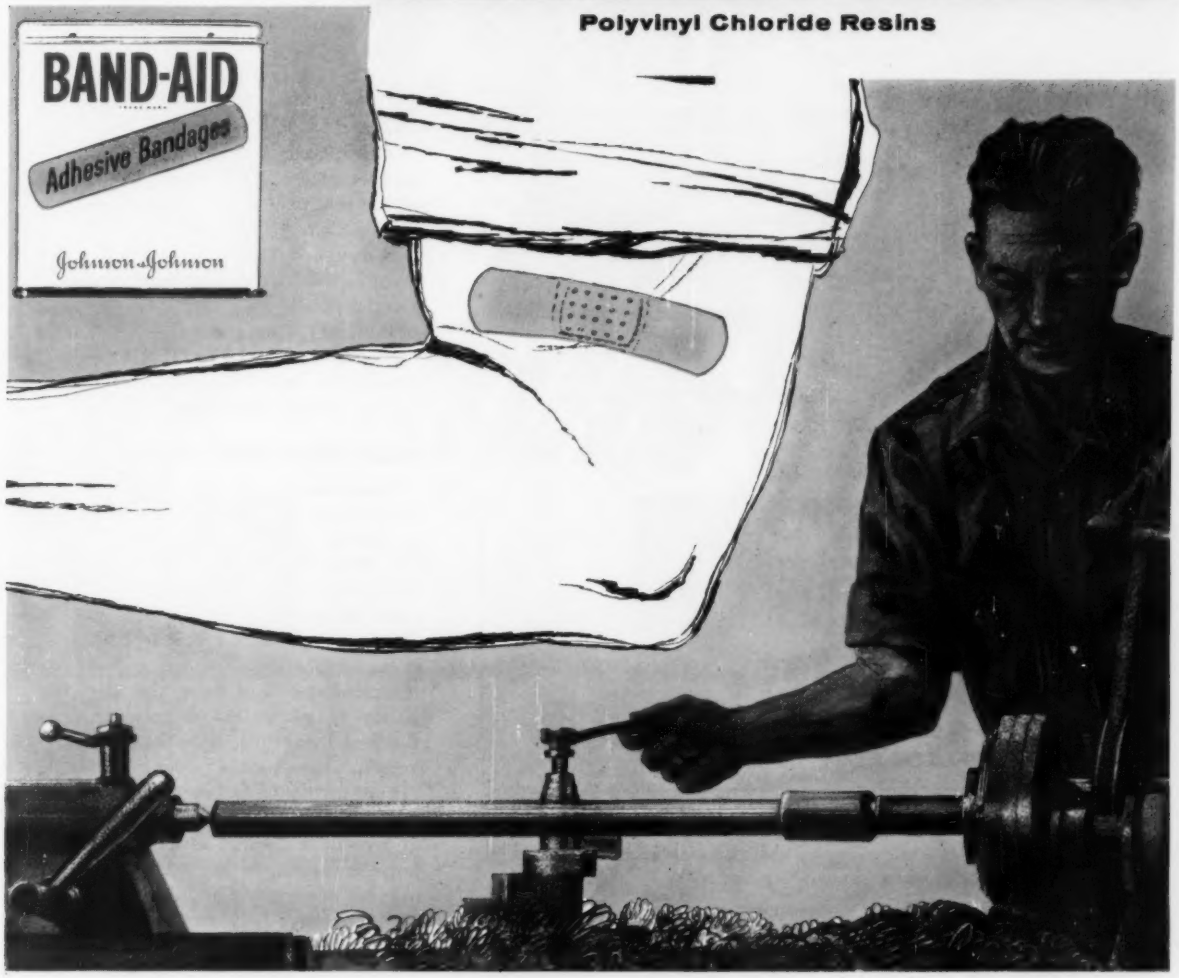

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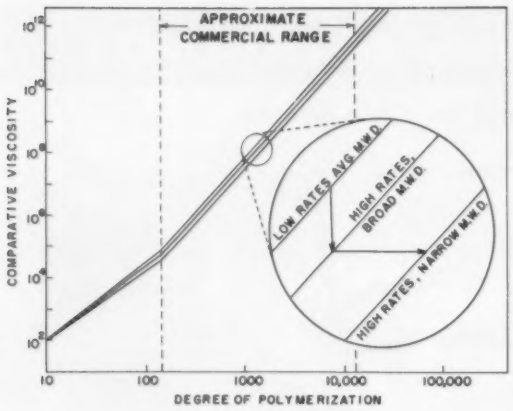

Fig. 4: Effect of degree of polymerization on viscosity (idealized curves). M.W.D.= molecular weight distribution

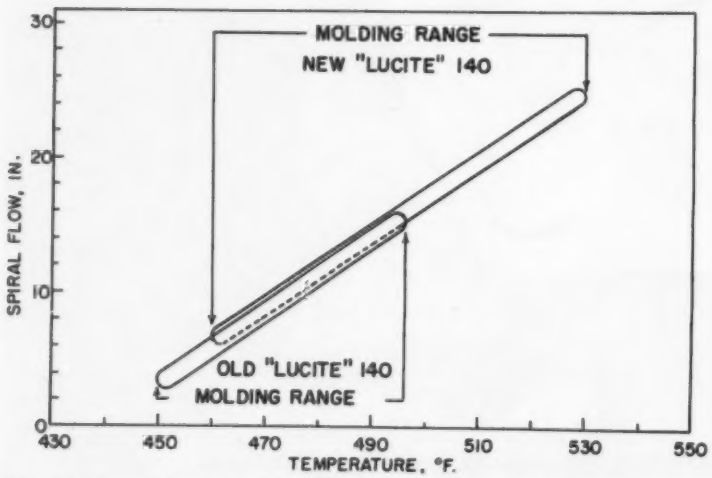

Fig. 5: Improvement of fabricability by change in molecular structure to increase upper molding temperature limit

cules for use as plastics may be narrowed down for the sake of simplicity to two properties that seem to be of basic importance. These are stiffness and toughness, which stand in a general way for resistance to slow distorting stresses and sudden fracturing stresses, respectively. The first requirement is to be able to get significant measurements of these properties.

There is little question about stiffness in this regard, but it is certainly important to dwell on the question of toughness, because so many methods are available to approach this property and there is so much doubt about what these methods mean with respect to usefulness in actual service. The Izod test is not satisfactory for reasons that Fig. 2, p. 156, makes clear. Although this is an excellent test for notch sensitivity, it is altogether misleading when used on unnotched pieces. Very contradictory results were obtained when attempts were made to use it to solve a problem relating to the ability of door-latch rollers molded from Zytel[1] 101 nylon to withstand a hammer blow without breaking. It is evident that there was no correlation of results from this simulated end-use test and the Izod impact test—in fact, the Izod results were almost exactly opposite to what this particular service did to the plastics pieces. To get a measure of the real usefulness of a plastic in this sort of use, a new holder was designed for the Izod equipment so that the sample would be given a tensile rather than a flexural blow.[2] This gives results of the right kind and in pretty good agreement with the door-latch roller service results.

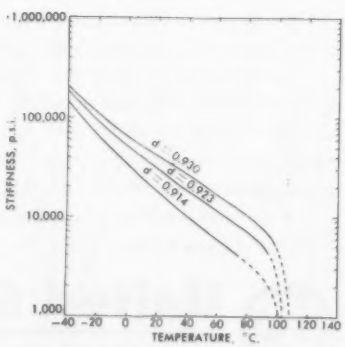

Fig. 6: Improvement in temperature resistance of polyethylene by changes in molecular structure associated with density (d)

Effects of chemical structure

Examination of the way in which some of these key physical properties are affected by chemical structure reveals that the most fundamental structural feature of all (Fig. 3, p. 156) is degree of polymerization. Given a chemical intermediate or set of intermediates that have the capacity to grow into a polymer, the first thing to note is that this growth process must be continued to an advanced stage before a useful material results. The stage of growth is defined as degree of polymerization, which means the number of repeated building units in the average polymer molecule. It is not the stiffness requirement that is controlling because some polymers achieve a major part of their ultimate stiffness at quite a low degree of polymerization and they all achieve a useful part of the stiffness long before certain other physical properties are achieved. As the idealized curves show, the property of toughness is not so readily achieved and in fact it is the necessity to raise this property to a useful level that sets the lower limit of a practical composition. For a range of actual materials this lower limit ranges from degree of polymerization 150 to 1000. Even then further increases in the degree of polymerization are usually accompanied by increased toughness.

There is another limit, however, to the degree of polymerization

[1]Registered DuPont trademark.
[2]Modern Plastics 33, 199 (June 1956).

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that is commercially practical, imposed by the requirements of fabricability (Fig. 4, p. 158). The viscosity of a polymeric material rises rapidly with increasing degree of polymerization; the practical effect of this is that the fabricator sets the top limit on the degree of polymerization that can be usefully employed. Even though the viscosity of a plastic can be reduced by heating it, the limit on heating imposed by thermal stability of the chemical structure sets an outside practical limit on degree of polymerization at about 20,000. Notice that both the fabricator and the materials manufacturer have some power to exert a degree of control over the useful range.

Although viscosity of the average polymer rises out of sight as degree of polymerization is increased, the effective viscosity is lower and consequently the range of practical fabricability is extended, when the plastic is processed at high fabrication rates. The high fabrication rates lower the effective viscosity by imposing high rates of shear on the plastic melt. The materials manufacturer may be able to hold to a practicable viscosity and still increase the degree of polymerization for better end-product properties, by controlling his synthesis to produce a narrow distribution of molecular weights in the polymeric material. Of course, there are a number of other considerations which in a given case may bar either or both of these measures.

Figure 5, p. 158, gives a practical illustration of the statement that the handicap of high viscosity can be overcome by heating the plastic up to the limit imposed by thermal stability of the polymeric material. The experience of a number of processors using a now obsolete type of acrylic resin indicated that reduced melt viscosity at molding temperatures would permit fabrication of larger, more complex articles which were desired by designers. It was desirable to attain this increased melt flow without sacrifice in other important characteristics such as resistance to deformation at elevated temperatures. By improving thermal stability, it was possible to use higher temperatures giving the desired reduction in melt viscosity. Figure 5 shows that the upper limiting molding temperature was extended from 495 to 530° F. without altering the lower operable molding temperature. Certain other modifications were combined with this development to produce an improved Lucite[1] 140 molding composition. Field experience has now shown that it is possible to mold very large panels for an automotive application which were heretofore impossible. Molding cycles have been reduced 20 to 30% in several molders plants where speedometer dials and automotive lenses are fabricated.

Quite another kind of change in polymer design for improved plastics properties is illustrated by the polyethylenes portrayed in Fig. 6, p. 158. In this case the property in question is stiffness, and particularly the retention of stiffness at elevated temperatures. It is highly important for many uses to have a polyethylene that possesses form stability at the temperature of boiling water. The chemical nature of polyethylene is such that the structural changes that affect this property most importantly are those associated with an increase in density;

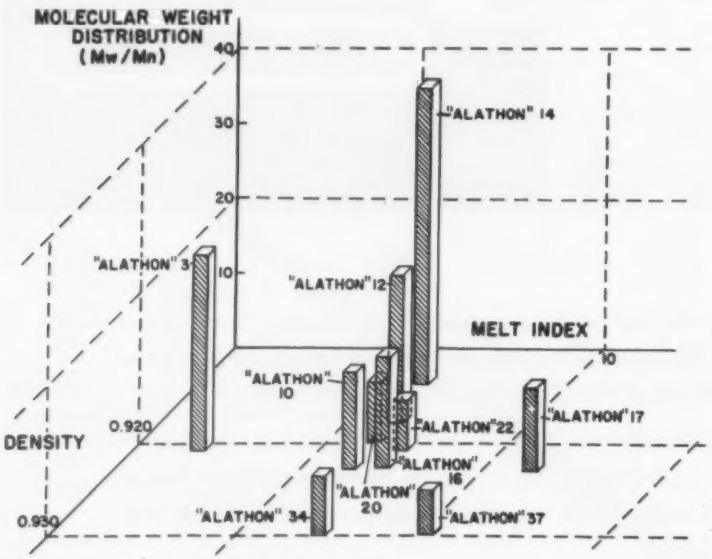

Fig. 7: Three-dimensional polyethylene map

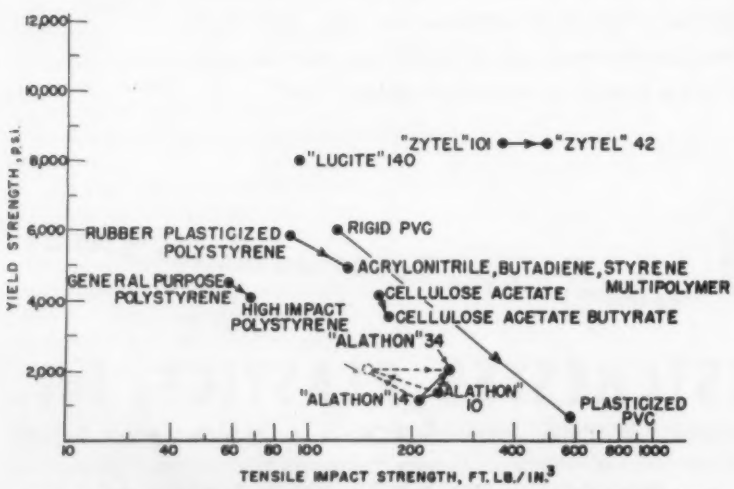

Fig. 8: Effect on yield strength of structural changes to increase toughness

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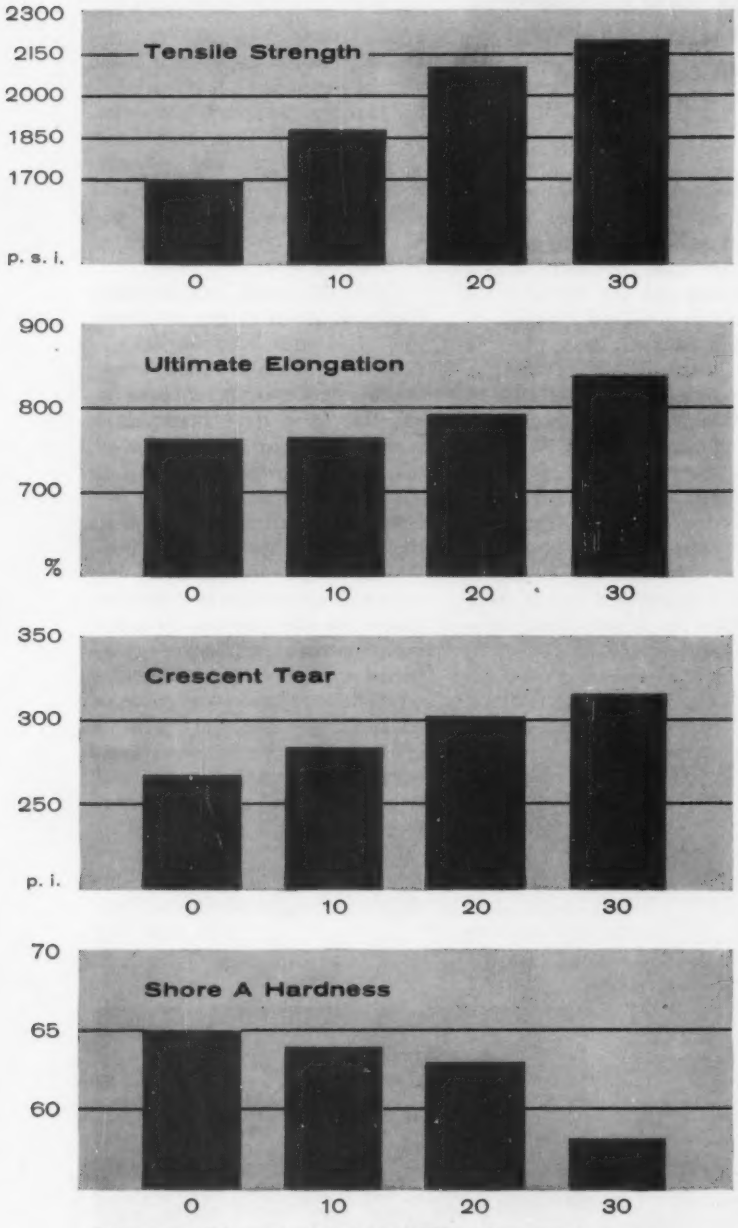

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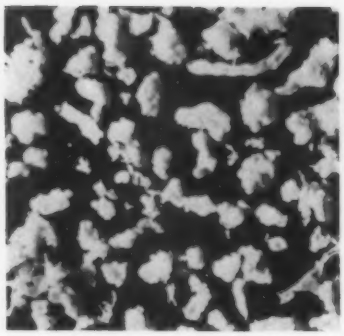

Fig. 9: Photomicrograph of coarsest particles, Teflon 1 material

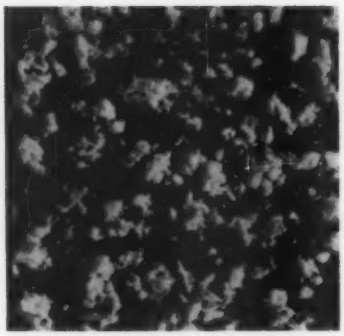

Fig. 10: Photomicrograph of finer particles, Teflon 5

by the correct design of our molecular structures, therefore, we are able to improve retention of stiffness at elevated temperatures progressively from a density of 0.914 (Alathon[1] 14) to density 0.923 (Alathon 10) and then to density 0.930 (Alathon 34). Although the polyethylene is now *capable* of retaining much of its stiffness at boiling-water temperature, an article will in fact stand sterilization by boiling only if it has been fabricated in such a way as to avoid extreme molded-in stresses.

Three features of molecular structure thus affect plastics properties in an important way: degree of polymerization, width of molecular weight distribution, and density. It happens that each of these three can be controlled independently to a considerable degree in the manufacture of polyethylene and so a well developed range of polyethylene resins can only be represented with respect to these three important properties by a three-dimensional map (Fig. 7, p. 160). Each of the compositions represented here has been defined to give the best balance of properties for some major end use or group of end uses, consistent with the requirements of ready processability.

A cautionary note is now in order. The relationship of physical properties of plastics to structural variables of the polymeric materials from which they are made is so complicated that steps to improve one property may involve sacrifice in another. This is well illustrated by Fig. 8, p. 160, on which a number of representative plastics are located with respect to their tensile impact strength and yield strength.

In the case of polyethylene just mentioned, the modification of structure involved in proceeding from Alathon 10 or 14 to 34 would produce an increase in yield strength, but a decrease in impact toughness if only density were changed. In fact, however, a simultaneous narrowing of the molecular weight distribution has produced instead an increase in impact strength. This is a very happy circumstance, especially in view of the fact that one of these properties is usually attainable only at the expense of the other. For example, when the chemical structure of a polymeric material is modified by copolymerization, by plasticization, etc. to introduce some toughness into a brittle composition, a loss of yield strength is usually involved. Note that the conversion of rigid polyvinyl chloride, which tends to be brittle, into a highly tough, plasticized vinyl composition involves a very substantial loss of yield strength. On a smaller scale, this is also true of cellulose acetate butyrate which is tougher than cellulose acetate but also lower in yield strength, and of polystyrene, which when modified for an increase of impact strength loses yield strength, and for the so-called polystyrene alloys which show the same trend. Nylon-6/6 is shown for completeness; although the change of molecular structure involved in converting Zytel 101 to 42 is intended to improve its suitability for processing by extrusion and should not affect yield strength, it is noteworthy that toughness is increased by this move.

Effects of physical form

Up to this point, consideration has been given to the modification of plastics materials chemically; in the case of Teflon[1] tetrafluoroethylene resin, changes in physical form have been found to contribute to the solution of fabrication problems and thus to aid processors in developing desired end-use properties even though the physical form produced by the operations of the materials manufacturer is not visible in the final product. As originally introduced, Teflon comprised a granular material having a particle size averaging about 0.6 mm. in diameter (Fig. 9, above). Although this was a useful form for compresion molding, it was recognized at an early stage that a somewhat more finely divided material could be more readily consolidated into cylinders for the fabrication of tape

(*To page* 273)

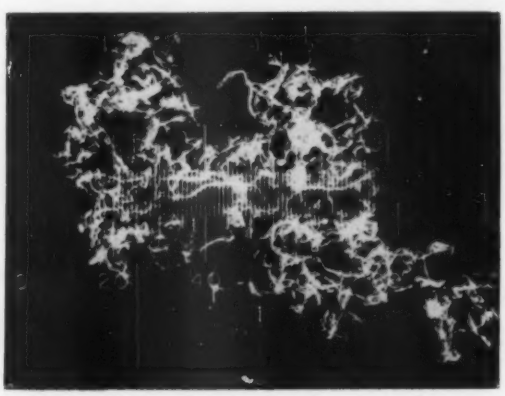

Fig. 11: Photomicrograph of fibrous particles, Teflon 7X

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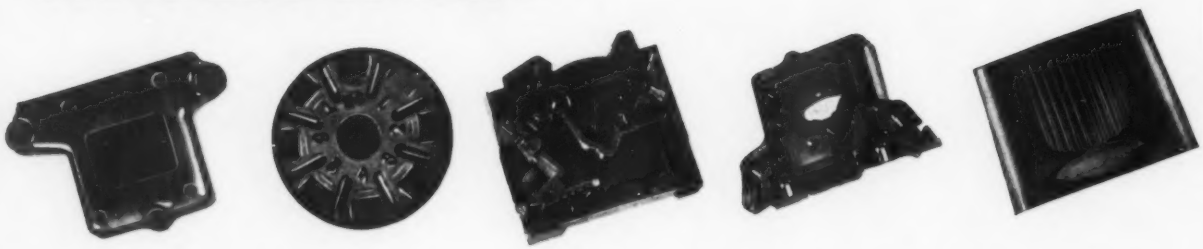

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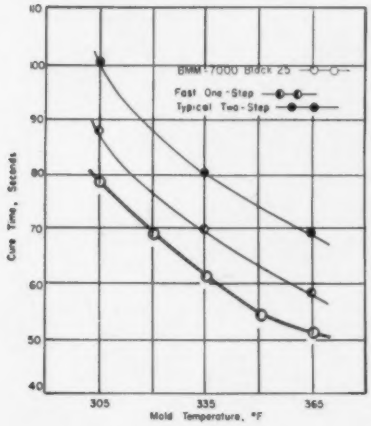
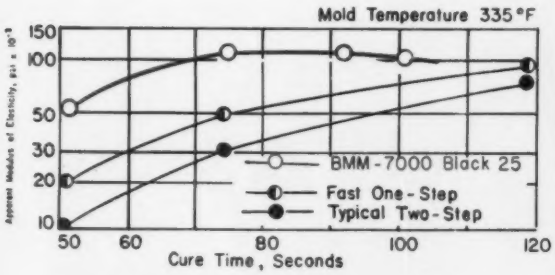
...a general-purpose two-step wood-flour filled phenolic molding material. Its cure speed is exceptional—faster than either two-step or very fast one-step materials. Intended for cold powder automatic molding, BMM-7000 can also be plunger molded on fast cycles.

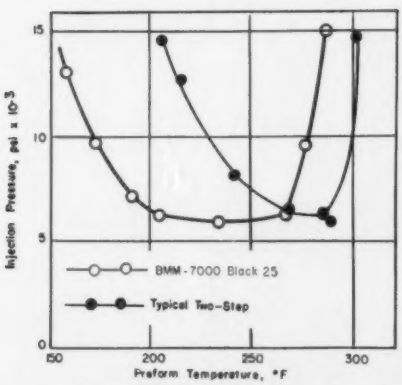
FAST CURE SPEED—BMM-7000 cured as fast at 315 deg. F. as a fast one-step material at 335 deg. F., and a two-step material at 365 deg. F., according to a test of minimum blister-free time in cold powder compression molding.



HOT RIGIDITY—BMM-7000 took 50 seconds to reach an apparent modulus of elasticity of 50,000 psi at 335 deg. F. A fast one-step phenolic took 50 per cent longer, a typical two-step material, 100 per cent longer.



MOLDING LATITUDE—As determined by plunger molding, BMM-7000 could be preheated over a wider range than general-purpose BMG-5000, and still give mold fill-out—an 87 deg. F. spread at 7500 psi, compared to 46 degrees for BMG-5000. This property makes the new material suitable for molding large pieces even with its fast cure speed.



IN ADDITION—BMM-7000 demonstrates good mold release, freedom from mold staining, low specific gravity, and low shrinkage.

TYPICAL TEST VALUES OF BAKELITE BRAND GENERAL-PURPOSE PHENOLIC COMPOUND BMM-7000

BMM-7000 BLACK 25 TYPICAL TEST VALUES

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Granulation (D392-38)	12 mesh*
Bulk Factor (D392-38)	2.3
Tabletting Qualities	Easily performed on standard equipment.
Pourability (D392-38), sec.	19
Plasticity Grades Available	6, 9, 12
Molding Shrinkage (D955-51), in./in.	0.004

*All grades supplied in special low fines granulation.

VALUES FROM ELECTRICAL TESTS

	60C	1 KC	1 MC
Dielectric Strength (D149-55T)			
Short time, volts/mil	330		
Volume Resistivity (D257-54T)			
ohm-cm	6×10^{12}		
Dielectric Constant (D150-54T)	6.1	5.7	4.6
Dissipation Factor (D150-54T)	0.08	0.04	0.03

VALUES FROM MISCELLANEOUS TESTS

Molded Specific Gravity (D792-38)	1.36
Heat Distortion Temperature (D648-45T)	
deg. F.	330
Water Absorption (D570-54T) % wt. gain	0.5

VALUES FROM MECHANICAL TESTS

Izod Impact Strength (D256-54T)	
(Ft. lb./in. of notch)	0.29
Compressive Strength (D695-54), psi	35,000
Tensile Strength (D651-48) (⅛"), psi	6,900
Flexural Properties (D790-49T):	
Flexural Strength, psi	9,000
Modulus of Elasticity in Flexure, psi	9.5×10^5

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Tests* prove that the mar resistance of vinyls containing FLEXOL 380 is comparable to that obtained with commonly used polymeric plasticizers. Look at these results—

Plasticizers (at 50 PHR)	% Softening of N/C lacquer, 40°C. 1 Day	2 Days	3 Days
FLEXOL 380	<10	13	20
Dioctyl phthalate	45	60	57
Polymeric A	18	—	—
Polymeric B	17	—	—
Polymeric C	45	—	—

*with a Walker-Steele Swinging Beam Hardness tester

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Measuring temperature dependence of mechanical properties of plastics

*By Katsuhiko Ito**

A simple and rapid method for measuring the temperature dependence of mechanical properties of plastics is proposed. This test is easily performed by obtaining Rockwell number-temperature curves with a Rockwell hardness testing machine and a small test specimen, which is heated at a constant rate of temperature rise, 2°C./minute. Thus, the thermal behavior of plastics, for example, transition to entropy elasticity, flow phenomena, and many effects of reinforcement, plasticizers, and other ingredients can be clearly demonstrated by Rockwell number-temperature curves.

Mechanical behavior of plastics depends not only upon primary bonding forces of molecular structure, but is also greatly influenced by secondary bonding forces such as van der Waal's forces. The temperature dependence of these bonding forces is one of the most important properties of plastics. Especially important in the molding of plastics are the transition from energy elasticity to entropy elasticity by the disassociation of secondary bonds and the temperature thereof, and the temperature at which flow becomes evident in linear polymers.

Heat distortion temperature by the three-point bending of a beam is one of the thermal properties of plastics specified by A.S.T.M. (D 648-45T). But this is very imperfect in physical meaning and as a testing method. To study the thermal behaviors of plastics, stress-strain curves in tension or compression tests at various temperatures, and the temperature dependence of these mechanical properties, especially the modulus of elasticity, should be considered. However, the proper execution of such measurements over a necessarily wide range of temperature involves a great deal of work.

Since the Rockwell hardness test is a comparatively simple method, based on deformation by a major load and recovery upon removal of the load, a rapid method based on Rockwell number-temperature curves is suggested for evaluating thermal behavior of plastics. Rockwell hardness number is related to the deformation and recovery of a plastic under load. By measuring the number at successive temperatures, a survey can be made of how plastics undergo softening

*Research associate, Div. of Engineering, Brown University, Providence, R.I.; research member of the Scientific Research Institute, Bunkyo-ku, Tokyo, Japan.

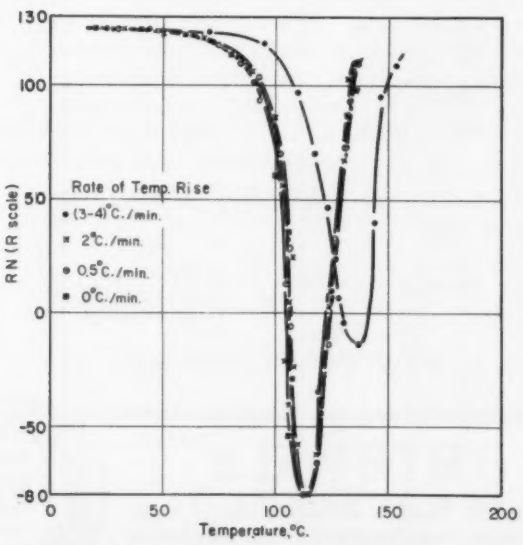

Fig. 1: Rockwell number-versus-temperature (RN-T) curves for epoxy cast resins

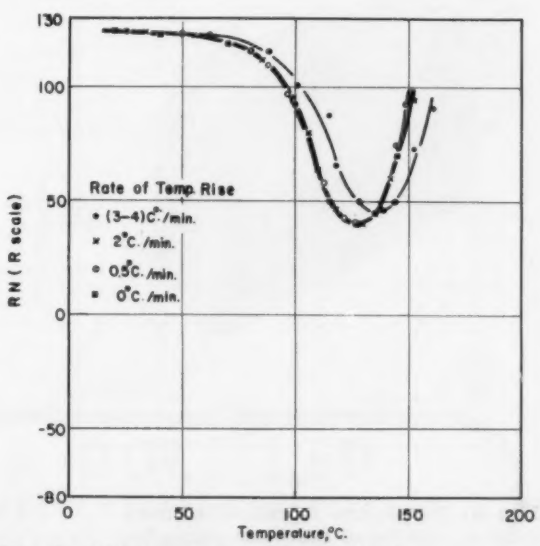

Fig. 2: RN-T curves for diallyl phthalate homopolymer cast resins

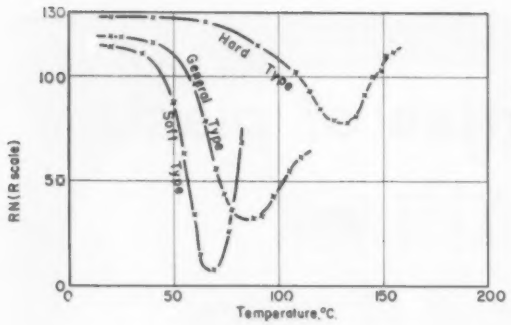

Fig. 3: RN-T curves for rigid polyester cast resins

with the rise of temperature and pass into entropy elasticity by the dissociation of the secondary bonds.

Test method

An electrically heated jig was attached to a Rockwell hardness testing machine[1] and the Rockwell number (A.S.T.M. D 785-51) of a small test specimen was measured by heating it at a constant rate of temperature rise, the test specimen being moved along by a screw thread to change the point of application. The rate of temperature rise was varied to suit the purpose but kept constant during one set of measurements by regulating the heating current. The temperature was read on a thermometer placed near the test specimen. The mean of the temperatures obtaining prior to and following the measurement was then recorded.

As the *R* scale is best suited to examining the thermal behavior of rigid types of plastics in general, it was used as a standard loading condition.

Curves for cross-linked polymers

Figure 1, p. 167, shows the Rockwell number versus temperature (RN-T) curves of epoxy cast resin[2] for several rates of temperature rise. Owing to the dissociation of secondary bonds, a very sharp change in the RN-T curves is observed in this figure.

RN-T curves of diallyl phthalate homopolymer (DAP)[3] for several rates of temperature rise are shown in Fig. 2, p. 167. Effects of the rate of temperature rise are similar to those observed for the epoxy cast resin. Compared with epoxy cast resin, the transition to entropy elasticity of DAP is probably of a more complicated nature than that of epoxy cast resin.

The rate of temperature rise of 2° C./min. corresponds to that of heat distortion temperature measurements (A.S.T.M. D 648-45T). A faster rate than 2° C./min. induces large experimental errors. At a slower rate, a resin that is not completely cured (for example, a polyester that is cured at room temperature using promoter) undergoes appreciable additional cure as a result of the heating during an experiment. Thus, the rate of 2° C./min. seems appropriate.

Figure 3, above, shows the RN-T curves of polyester cast resins (unsaturated alkyd resin containing styrene) at the rate of 2° C./min. These rigid polyester cast resins were cured at an elevated temperature without a pro-

[1]The apparatus is described and illustrated in J. Sci. Res. Institute (Tokyo, Japan) 48, 154 (1954).

[2]About 21% of the epoxy resin is phthalic anhydride used as hardener. Heating condition for curing: 150° C., 7.5 hours.

[3]Benzoyl peroxide (2%) was added as catalyst. Heating condition for curing: 70° C., 16 hr.; 70 to 110° C., 1 hr.; 110° C., 5 hours.

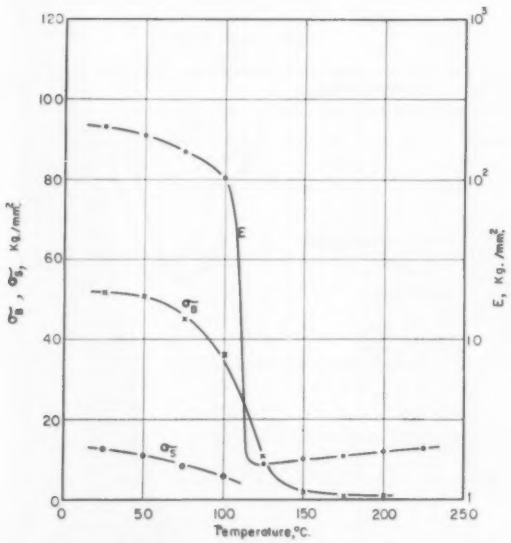

Fig. 4: Temperature dependence of compressive properties of epoxy cast resins; E= modulus of elasticity; σ_s=upper yield point; σ_b=ultimate compressive strength

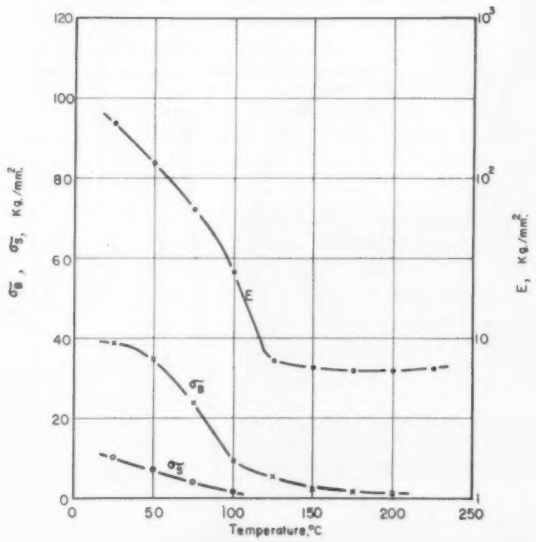

Fig. 5: Temperature dependence of compressive properties of diallyl phthalate homopolymer cast resins. E=mod. of elasticity; σ_s=upper yield point; σ_b=ult. comp. strength

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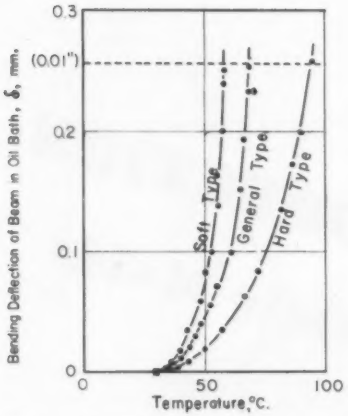


Fig. 6: Heat distortion curves for three rigid polyester cast resins

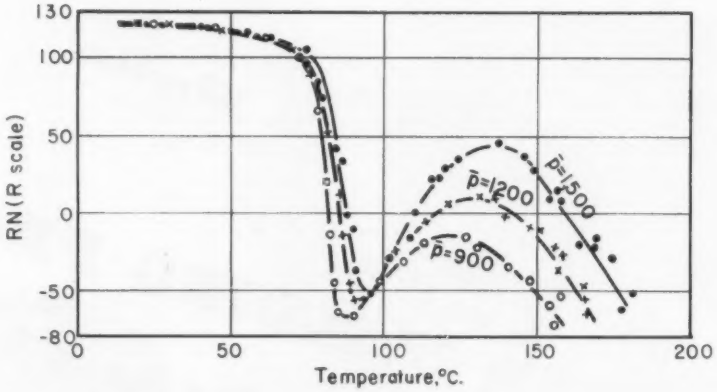


Fig. 7: Rockwell number-versus-temperature curves for hard polyvinyl chloride resins; $\bar{p}$ and associated numbers=degree of polymerization (weight average)

moter. As is obvious from an inspection of the graph the curves for the three rigid types (hard, general, and soft) are distinctly different.

Relationships to other properties

Comparison with compression in hot state. RN-T curves of Figs. 1 and 2 for the epoxy and DAP cast resins were compared with thermal behavior under simple stress distribution, i.e., effective stress-strain curves in compression at the respective temperatures. The results are plotted in Figs. 4 and 5, p. 168. As previously mentioned, the epoxy cast resin shows a sharper transition to entropy elasticity than does the diallyl phthalate resin, due to abrupt dissociation of the secondary bonds, which are probably mainly hydrogen bonds. These relationships are very similar to those observed in the RN-T curves.

Thus, from RN-T curve measurements, which can easily and rapidly be performed on a small test specimen, an insight into the thermal behavior dependent upon molecular structure can be gained.

Relation to heat distortion temperature and mechanical properties at room temperature. RN-T curves of cured polyester cast resin were compared with heat distortion temperatures and mechanical properties at room temperature. Results obtained are shown in Fig. 6, above; the mechanical properties at room temperature are listed in Table I, below. When these experimental results are compared with the RN-T curves shown in Fig. 3, certain correlations are observed. The harder the polyester resin, the higher are the heat distortion temperature, the modulus of elasticity E, the yield point, and the minimum temperature of the RN-T curves. Thus, RN-T curves give again a key to the mechanical and thermal properties.

Curves for linear polymers

Linear polymers differ from cross-linked polymers in that they have intermolecular macrobrownian motion which is responsible for the flow. This state causes a maximum to appear on the RN-T curves at a temperature higher than the elasticity transition point. A curve for unplasticized polyvinyl chloride,

Table I: Mechanical and thermal properties of polyester rigid cast resins (unsaturated alkyd-styrene copolymer)

Properties	Polyester rigid cast resin — Hard type	General type	Soft type
RN-T curve			
Temperature at min. point of RN-T curve, °C.	133	88	69
Rockwell number at min. point, R scale	78	32	8
Heat distortion temperature, °C.	94	69	58
Compressive properties at room temperature			
Modulus of elasticity (E), kg./mm.²	420	300	180
Upper yield point, kg./mm.²	17.4	12.2	7.3
Lower yield point, kg./mm.²	15.4	9.0	6.85
Rockwell hardness number, M scale	119	98	—26

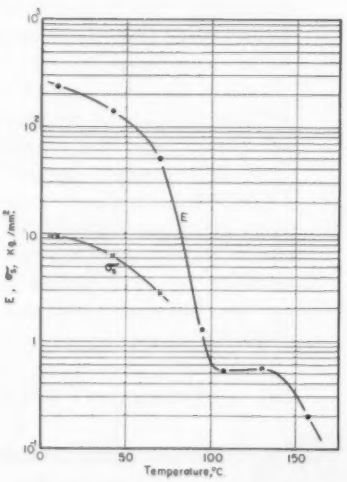
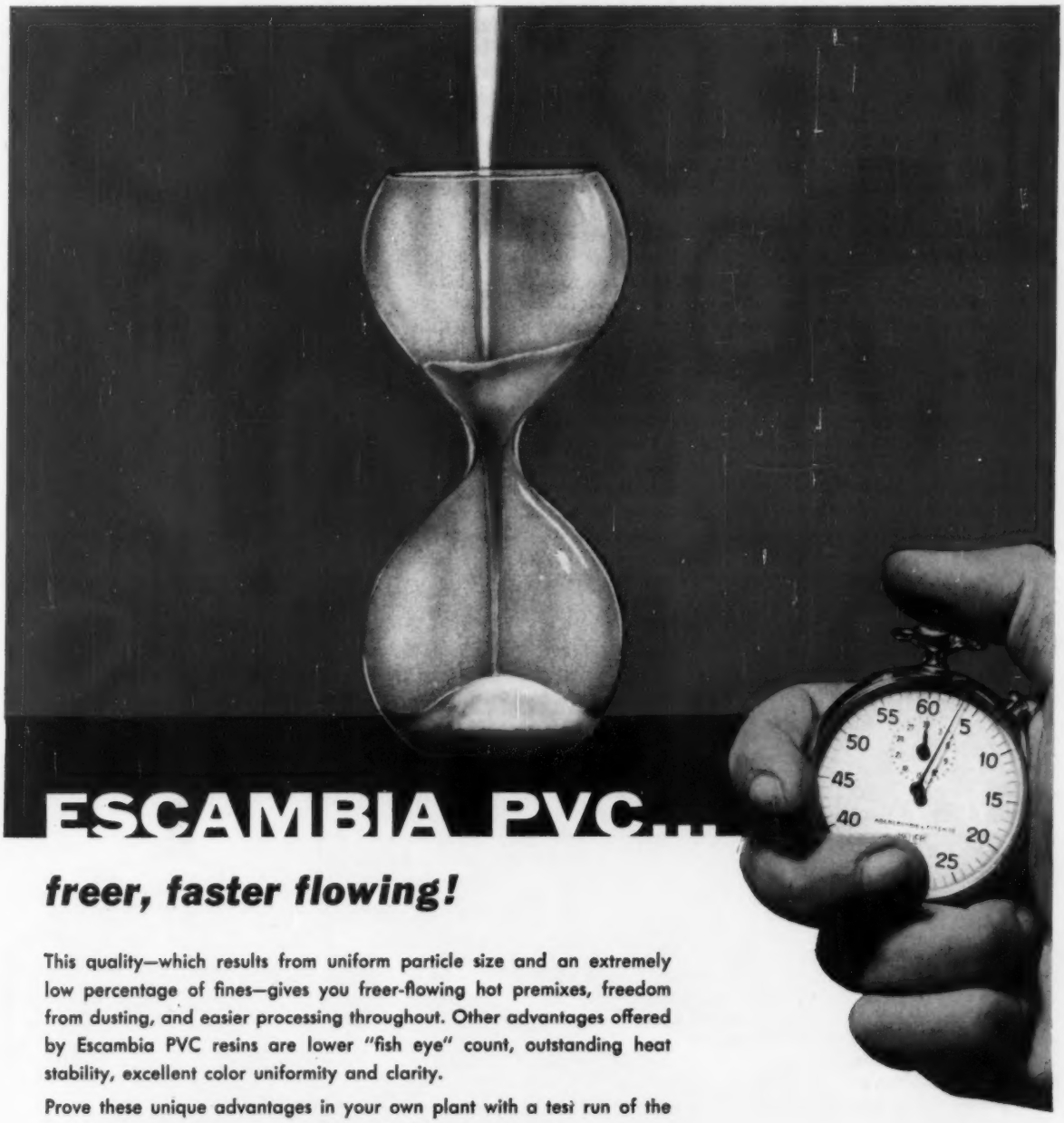


Fig. 8: Temperature dependence of compressive properties of hard PVC (no plasticizer, $\bar{p}$=1500). E= modulus of elasticity, σ_u= upper yield point



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degree of polymerization ($\bar{p}$) = 1500 (weight average), is shown in Fig. 7, p. 170.

As in the case of cross-linked polymers, thermal characteristics were studied by a hot compression test on unplasticized polyvinyl chloride; the results are shown in Fig. 8, p. 170. A comparison of the curves in Figs. 7 and 8 reveals that, with linear polymers too, the yield point becomes indistinct with the rise of temperature and RN-T curve shows a minimum at the threshold temperature to entropy elasticity. At higher temperature the resin softens rapidly.

The results on unplasticized polyvinyl chloride of degrees of polymerization 1500, 1200, and 900, respectively, are shown in Fig. 7 and Table II, below. Other mechanical properties are also listed in Table II. The effect of degree of polymerization is undetectable from the results of the simple mechanical tests except the RN-T curves.

In view of the practical applications of postforming, knowledge of the thermal behavior of laminates is important. Phenolic cotton-fabric laminates and polyester glass-cloth laminates were tested. The polyester resin used was the same material as used for the tests shown in Figs. 3 and 6 and Table I.

RN-T curves on these laminates are shown in Figs. 9 and 10, below. Minima appear in the RN-T curves as seen in the figures.

Compared with the RN-T curves of cast polyester resin shown in Fig. 3, the curves of the laminate show less change with temperature rise; the transition temperature to entropy elasticity is somewhat higher, owing to the presence of the reinforcement materials. However, the thermal behavior of laminates is also measured simply and rapidly by this method.

Conclusion

Mechanical behavior of plastics as affected by rising temperature, such as the transition to entropy elasticity, flow caused by intermolecular rearrangement, etc., is easily and rapidly analyzed by determining Rockwell number-temperature curves on a small test specimen. The results for cross-linked and linear polymers correlate with experimental data obtained by other mechanical tests. For laminates, the behavior is considerably affected by reinforcement materials. The Rockwell number-versus-temperature curves constitute a helpful guide to the practical molding of plastics materials.

Acknowledgements

The author expresses his thanks to Dr. S. Fukui and Mr. T. Akita for their stimulating interest throughout the course of this study. This study was performed in the Scientific Research Institute in Tokyo; its main support was derived from a subsidy of the Ministry of Education, Japan, and the research fund of the Riken Synthetic Resin Co. Ltd. in Tokyo.

Table II: Mechanical and thermal properties of hard polyvinyl chloride having different degrees of polymerization

Properties	*Hard polyvinyl chloride (no plasticizer)* $\bar{p}$=1500	$\bar{p}$=1200	$\bar{p}$=900
RN-T curves			
Temperature at minimum point of RN-curve, °C	92	89	84
Rockwell number at minimum point (R scale)	−50	−58	−66
Temperature at maximum point of RN-curve, °C	137	131	122
Rockwell number at maximum point (R scale)	43	13	−17
Compressive properties at room temperature			
Modulus of elasticity, kg./mm.^{2}	230	220	260
Upper yield point, kg./mm.^{2}	9.2	9.3	9.2

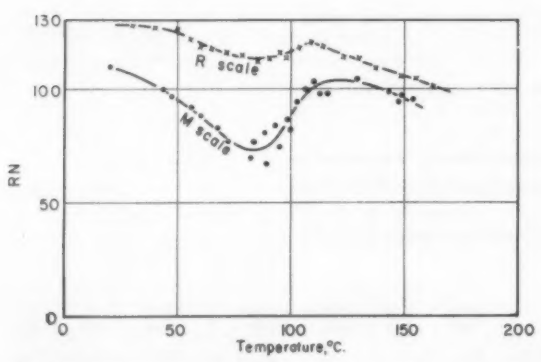


Fig. 9: RN-T curves for polyester (general type) glass cloth laminate

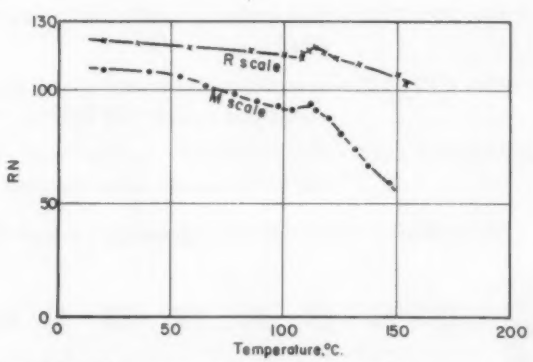
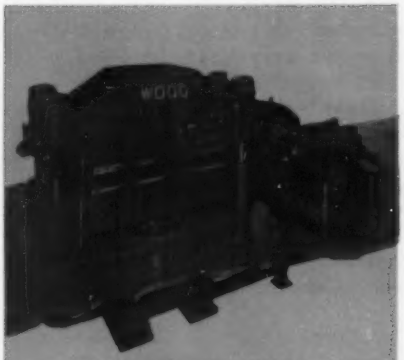


Fig. 10: RN-T curves for a phenolic-cotton fabric laminate



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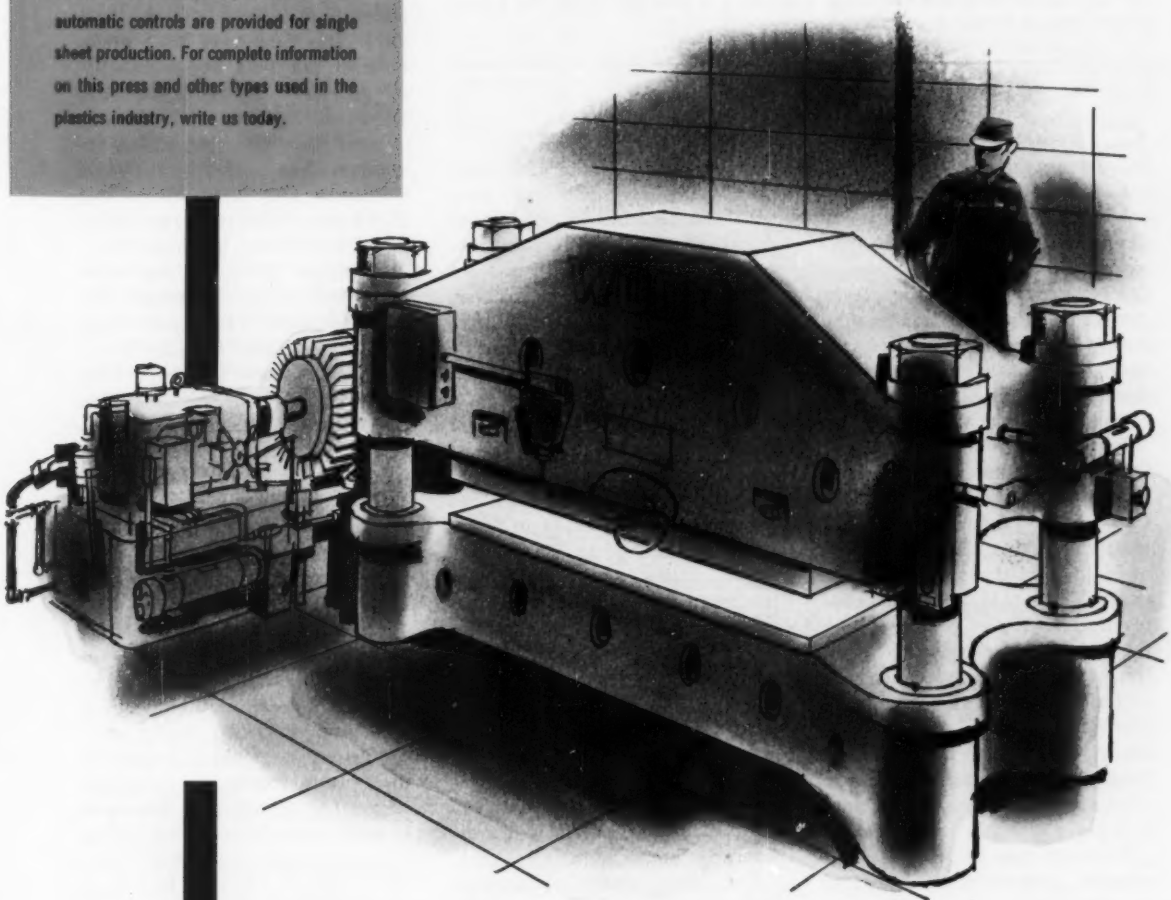

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Hydrostatic pressure effect on polymer melt viscosity

By Bryce Maxwell and Alex Jung†*

Measurements were made of the apparent viscosity of melts of polyethylene (branched) and polystyrene at constant shearing stress while the melts were under controlled hydrostatic pressures varying from zero to 24,000 p.s.i. The apparent viscosity of polyethylene increased 14-fold in this pressure range. The apparent viscosity of polystyrene increased 135-fold as the hydrostatic pressure was increased from atmospheric to 18,000 p.s.i.

The apparatus used in these measurements is described, the significance of the data in molding and extruding operations is presented, and the results interpreted in terms of polymer structure.

Successful molding or extrusion of high polymers requires a comprehensive knowledge of the interrelationships existing between the variables of temperature, pressure, and flow. It is, therefore, quite common to find research emphasis directed toward elucidating what effects these relationships have on fabricating techniques.

In all methods of fabrication of thermoplastic materials, the polymer is first heat-plasticized and then forced to flow from the heat-plasticizing area into a die or mold to form the material to the desired shape. If sufficient heat-plasticizing capacity is provided, then the flow characteristics of the melt become the controlling material characteristics of the fabricating cycle. That is, the viscosity of the material under the temperature, pressure, and flow rate encountered in the fabrication cycle controls the operation.

Viscosity may be defined as the internal resistance to shearing stresses due to inter- and intramolecular forces of attraction. Ideally it is often assumed to be a constant for any given material. For actual materials, however, it has been shown to vary with temperature and rate of shear. Because of this variable dependence, the term "apparent viscosity" has frequently been used to describe the behavior of a specific material under specific conditions of temperature and shear rate.

Because of the importance of apparent viscosity to commercial fabrication operations it is not surprising that the literature has numerous references (1 to 8, inclusive)[1] devoted to the investigation of this property. What is not immediately apparent, however, is that these investigations by and large consider only the effects of hydrostatic pressure on viscosity. In fact, some investigations use pressures over various areas as driving forces and therefore may not be comparable. Because of this it was felt that such an investigation would be of considerable importance.

For this study commercial high-molecular-weight samples of polystyrene and polyethylene (branched) were selected as typical examples of a pure, linear, amorphous polymer and a pure, essentially linear, polycrystalline material, respectively. These two materials were also considered desirable choices for initial study because of their very large commercial importance.

In the vast majority of flow studies the simplifying assumption of an incompressible liquid is made for ease in mathematical interpretation and also because very little data have been available on the bulk compressibility of polymers under hydrostatic pressure. Spencer (9) demonstrated that polymer melts are compressible and Maxwell and Matsuoka (10) have shown that this compressibility is non-linear and visco-elastic in nature.

Compressibilities of the order of 1% volumetric change per 1000 p.s.i. pressure (10) have been found for melts of polystyrene and polyethylene. In the rubbery state polystyrene exhibits two distinct bulk moduli,—one associated with the true melt and one of much higher magnitude associated with the glassy state. At temperatures in the range above the rubbery state only the bulk modulus of the true melt has been observed.

Polyethylene melts when subjected to hydrostatic pressure exhibit a somewhat different behavior. Because of their regular structure with no bulky side groups on the chain it is possible to pressure-induce the formation of regular crystalline structures at melt temperatures. The higher the melt temperature, the higher the pressure required to induce crystallization.

In view of the indicated high compressibilities of these polymer melts, one would expect a marked increase in apparent viscosity upon the application of hydrostatic pressure.

When the polymer is made to flow through a runner or die in

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Based on an M.S.E. thesis prepared under a fellowship sponsored by Celanese Corp. of America.

[1] Numbers in parentheses link to references at end of article, p. 276.

injection molding or extruding operations, any cross-section of the material is subjected to a hydrostatic pressure resulting from the driving force of the equipment on one side and the frictional resistance to flow of the material ahead on the other side. This pressure may reach several thousand pounds per square inch in machines commercially used today.

Basic theory

The viscosity of a liquid (η) relates the rate of shear (dv/dy) to the shear stress (γ).

$$\frac{dv}{dy} = \frac{1}{\eta}\,\gamma \qquad \text{Eq. 1}$$

Apparatus of any geometric configuration in which the shear stress and the rate of shear can be determined may be used to measure viscosity. Simple geometry is to be desired in order to simplify the measurement of these quantities.

Flow through a cylindrical capillary of large length-to-diameter ratio has been found to be one of the more useful techniques for measuring viscosity of polymer melts. The high length to diameter reduces the significance of entrance effects and the simple geometry facilitates calculation of shear stress and shearing rate.

By the use of Poiseuille's equation for liquid flow through a capillary,

$$\eta = \frac{\pi r^4 \Delta P}{8\,Ql} \qquad \text{Eq. 2}$$

the viscosity can be measured if the driving force (ΔP), the flow rate (Q), and the capillary dimensions (r) and (l) are known quantities.

This equation is based upon several important assumptions. These are that:

1) The fluid exhibits Newtonian behavior.

2) The fluid is non-compressible.

3) Laminar flow exists.

4) There are no entrance or exit pressure effects.

The latter two assumptions are attainable. However, the first two premises are largely invalid with polymer melts. Nearly all such melts act in a non-Newtonian fashion, and the fact that these melts are not incompressible is the prime motivation for this study.

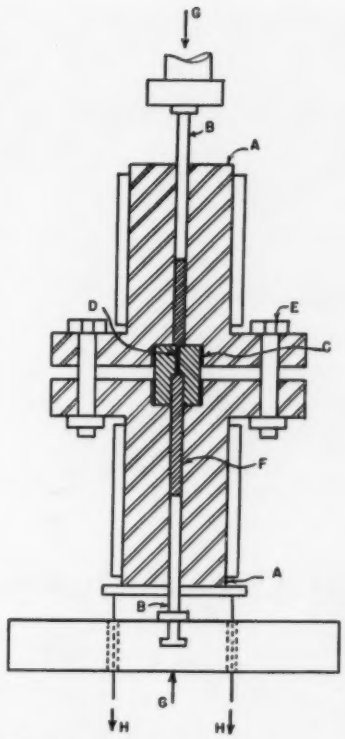

Fig. 1: Schematic diagram of test apparatus

Hence considerable caution must be exercised in applying this equation. The relationship does serve a useful and convenient purpose, nevertheless, when only magnitude differences in polymer viscosities are sought. It would be foolish, however, to correlate viscosities indiscriminately without recognizing the above limitations.

The Poiseuille relation was used in this study despite its shortcomings inasmuch as it represents the only viscosity relationship available with any merit. This was done fully realizing that only relative viscosity magnitudes could be determined with the polymer melts. Hence the term *apparent viscosity* is used to differentiate the results from the *idealized viscosity*.

In order to make the use of this equation more acceptable, the apparatus orifice and flow conditions were designed to approach laminar flow. True viscous flow assumes a parabolic velocity profile across the orifice. Obviously, as liquid enters the orifice it does not immediately form a parabolic cross section. However, this shape may be approached as the liquid moves down along the length of the tube. Therefore, to assure some degree of laminar profile, a large length-to-diameter capillary ratio is needed. For this investigation 20:1 was used.

Apparatus

In order to measure apparent viscosity of melts subjected to high hydrostatic pressure by the capillary flow method, some means of applying hydrostatic pressure independently of the force driving the material through the capillary had to be devised.

The method selected is illustrated by the schematic drawing (Fig. 1, left). Two steel cylinders (A) were drilled, reamed, and lapped to accurately accommodate two nitralloy plungers (B). A shallow cylindrical area was cut out of the end of each cylinder to hold the die (C) containing the capillary (D). The two cylinders were clamped together by means of the bolts (E). This clamping pressure in conjunction with appropriate gasketing material prevented leakage of material around the capillary die block.

The hydrostatic test pressure was applied to the polymer melt sample (F) by means of a hydraulic jack operating in the direction shown by the arrows (G). The differential driving force to make the melt sample flow through the capillary was applied to the whole cylinder assembly by means of dead loads acting in the direction of arrows (H). This results in the sample being subjected to the desired hydrostatic test pressure through the plungers while at the same time the melt is forced to flow through the capillary because of the relative motion, caused by the weights, of the cylinder and capillary assembly with respect to the plungers. Hence a known driving force is applied to the melt while it is under a known hydrostatic pressure.

The hydrostatic pressure gen-

(*To page* 178)

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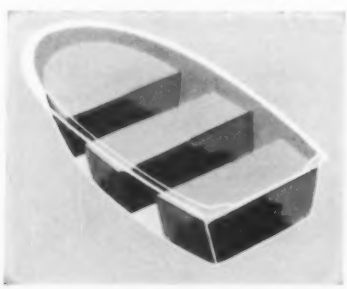

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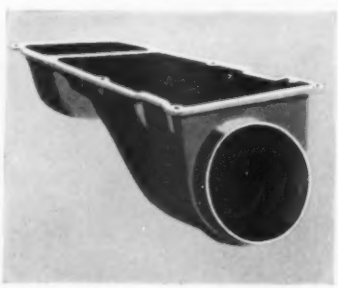

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erating unit is a simple hydraulic hand pump. One of the fundamental advantages of the entire apparatus is its relative simplicity of operation, compactness, and portability.

The hand pump, thus, represents one of the critical features in offering these advantages. Previous work (10, 11) resorted to large, universal testing machines to develop pressure, thus precluding simplicity. Figures 2 and 3, below, show the apparatus used in this investigation disassembled and assembled.

Each cylinder is heated with a full-round electrical heater band which effectively covers most of the external area of the cylinder. A rheostat is employed to control the power input and hence the total heat output of these heating units.

Sufficient capacity is designed into the heaters to permit temperatures in excess of 500° F. Temperature readings are taken with a bayonet-type iron-constantan thermocouple placed in a well, drilled in one of the cylinders. The tip of the thermocouple is located very near the die capillary; thus melt-temperature readings with a high degree of reliability are attained.

The amount of flow taking place is measured automatically through a linkage and recorder. The operation of this device is explained in detail in the next section on procedure.

Procedure

The specimens used in this work were injection molded with a 1-oz. Watson-Stillman injection machine. They were molded in a cylindrical shape ¼ in. in diameter by 3½ in. long. Part of each end of the specimens was cut off with a band saw so that the final length was 3 inches. This dimension is not critical since the total amount of flow is measured and thus is not dependent upon the original length of the specimen. The 3 in. represents an arbitrary length which was found convenient for design purposes. The ¼-in. diameter also is not critical for the same reason.

Prior to an actual test, the apparatus is thoroughly cleaned and assembled. Following a run, the equipment is disassembled and cleaned ready for reassembly. No specimens were used twice in order to eliminate the possibility of using a degraded material for the test.

Putting the instrument together is relatively simple. The die fits snugly into the seats cut out of each cylinder and positions the latter. As shown in the diagram, the nut and bolt system then insures a tight seal between the die faces and cylinders. To further decrease the possibility of a high-pressure leakage past these interfaces, a thin (1-mil) copper gasket is placed between each die-cylinder interface. This gasket also decreases the possibility of steel-to-steel seizing.

Once the gaskets and die are in place the bolts are drawn down tightly to seal the entire unit. Care is required to draw the bolts down evenly and snugly; otherwise a serious leakage can occur; pressures of 24,000 p.s.i. were used in some runs.

One of the rams is then placed into the top cylinder. The ram for the lower cylinder is fastened to a steel bracket on the table where it remains in a fixed position.

The piano wire part of the weight-carrying cradle is affixed to the bottom cylinder and the equipment is now ready for final assembly.

The 3-in. specimen is inserted in the bottom cylinder and the entire bolted section placed on the fixed lower ram. The loose-hanging piano wires go through holes drilled in the steel bracket holding the lower ram. The second half of the weight cradle is then slipped on the piano wires as they protrude beneath the table.

Next the hand pump, which is

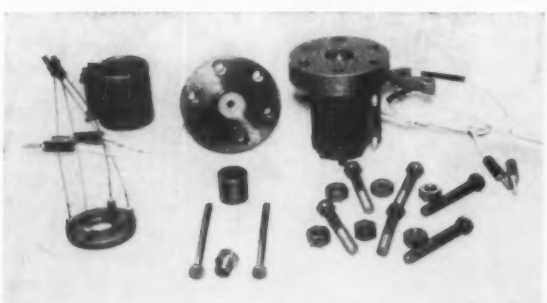

Fig. 2: Disassembled view of apparatus

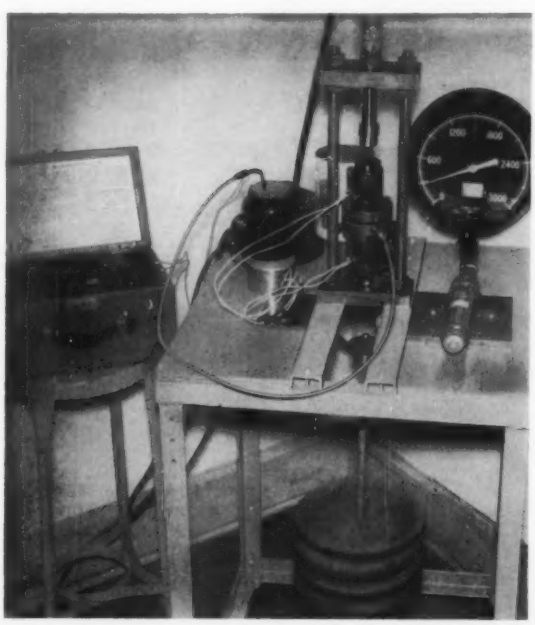

Fig. 3: Apparatus assembled and set up for test

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part of a jack with the jack section upside down facing the lower steel bracket, is pumped up. This action brings the jack into contact with the ram placed in the top cylinder. Until this contact is made, the lower ram supports the entire apparatus.

After the apparatus is in its final state of assembly and aligned, heat can be put into the band heaters. By properly setting the rheostat, the desired temperature can be readily obtained. The heat-up to equilibrium usually requires 1 to 1½ hours. It is thought to be both desirable and experimentally consistent to apply the test hydrostatic pressure on the sample throughout the warm-up period. As the polymer absorbs heat, however, expansion takes place. This in turn causes a pressure increase. Therefore, some of the pressure should be bled off as required.

The reader should be reminded that the bolted cylinders with the enclosed orifice die are free-moving on the rams. Since the rams are actually stationary and the free motion of the cylinders is downward (with the influence of dead weights to cause flow), the polymer melt flows upward with respect to the cylinder assembly. Therefore, the specimen is inserted in the bottom cylinder. Thus, in view of this arrangement, the material flows through the orifice and then into the bore of the upper cylinder.

A recorder measures the total downward movement of the clamped apparatus and hence also the flow of the polymer melt. Simultaneously the time of flow is recorded; thus the set-up yields a measurement of volume-per-unit time rate of flow.

The recorder consists of a brass drum with graph paper around it revolving at constant speed. A pen attached by means of a brass linkage to one of the cylinders records the flow. As the equipment travels downward, the pen travels with it and hence records the distance of flow. Since the drum recorder is revolving at a known speed, the time of flow for a given distance is recorded.

The rate of flow can be varied by adding or subtracting iron weights from the cradle. A maximum of 374 lb. can be used with this equipment. Thus, since the apparatus itself weighs 12 lb., a total driving force of 386 lb. is available to cause flow.

Once temperature equilibrium is reached and the desired hydrostatic pressure regulated, a test run can be made. First a steel block is placed under the lower cylinder to prevent flow from occurring while the driving force weights are applied. After the desired amount of weights are added and all other test conditions have been checked, the recorder is turned on and the steel stop block removed. The weights, therefore, pull the apparatus over the stationary bottom ram, and cause the polymer melt to flow upward. The nut that secures the bottom ram into the steel bracket also acts as a stop for the equipment's travel downward.

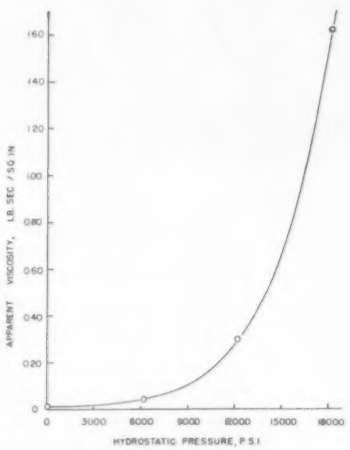


Fig. 4: Apparent viscosity of polystyrene as a function of hydrostatic pressure

Since the determination of the viscosity of the melt is dependent only on the resistance to flow of the material going through the capillary, calibration of machine friction and retarding forces due to melt flowing outside the capillary must be determined. To do this a blank capillary die with a ¼-in. hole was placed in the apparatus and calibration runs were made at the same experimental conditions as the runs with the capillary present. Thus, the resistance to flow with the capillary present minus the resistance to flow without the capillary gives the true resistance to flow of the melt through the capillary.

The capillary used for the apparent viscosity measurements had a 0.022-in. diameter and a 20:1 length-to-diameter ratio. All tests were performed under a driving force that produced a 7880 p.s.i. shear stress on the melt. Although 30,000 p.s.i. hydrostatic pressure was available, measurements were made only to 24,000 p.s.i. The reasons for this are explained below.

Results for polystyrene

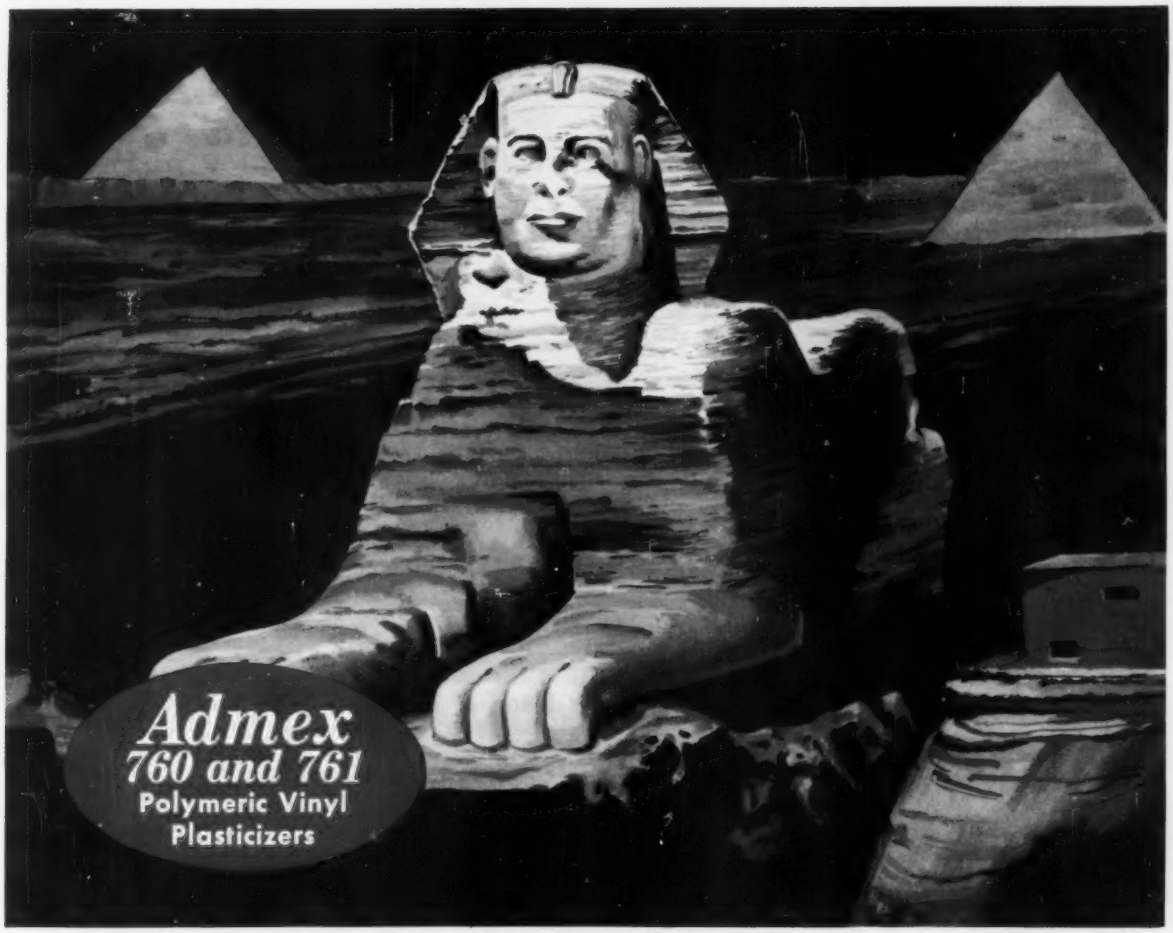
In order to be certain that tests were performed on true melts, a test temperature of 385° F. was selected for polystyrene. Bulk compressibility studies (10) indicate that no rubbery state response is exhibited by this material at this temperature.

The apparent viscosity of polystyrene as a function of hydrostatic pressure is shown in Fig. 4, left. A remarkably large increase with hydrostatic pressure is observed. Starting at atmospheric pressure the apparent viscosity increases slowly as the pressure applied to the melt is increased. At around 9000 p.s.i. hydrostatic pressure the rate of increase of apparent viscosity increases markedly so that at 18,000 p.s.i. hydrostatic pressure the apparent viscosity is 135 times the atmospheric value.

Above 20,000 p.s.i. flow was no longer measurable under the test conditions. The polymer melt acted like a solid plug.

An explanation of the marked viscosity increase may be based upon the structural configuration of polystyrene. This polymer contains large, bulky benzene rings which cannot avoid interfering with each other when a compressive load is applied. There is no opportunity for the chains to assume an ordered configuration. As a consequence, the melt viscosity increases quickly as pressure forces these large substituent groups close together into a disordered pattern.

As mentioned earlier, the results of this work have implications to commercial operations. An illustrative example of this concerns injection molders. It is commonplace for fabricators to



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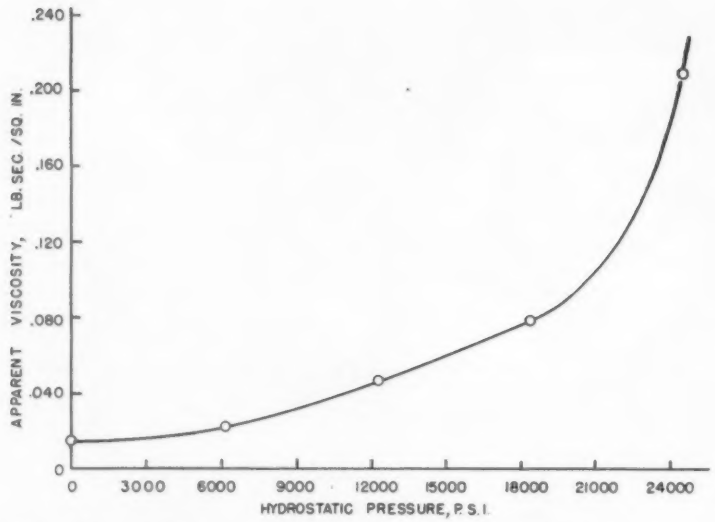

Fig. 5: Apparent viscosity of polyethylene versus hydrostatic pressure

increase injection pressures in an effort to decrease molding cycles; the thought being, of course, to fill the mold cavities as quickly as possible. As shown by these data, however, a pressure increase will concurrently increase the apparent melt viscosity. Thus the application of higher and higher pressures becomes, in effect, self defeating with no net advantage to the molder.

It is interesting to note that present day machines are operating with 6000 to 7000 p.s.i. maximum pressure exerted upon the molten polymer. This is very near the pressure range where abrupt viscosity changes become pronounced with small pressure increases.

Obviously from the foregoing, optimum molding conditions can be arrived at only with a full appreciation of this hydrostatic pressure-viscosity phenomenon.

Results for polyethylene

Measurements of the apparent viscosity of polyethylene were performed at 300° F. This temperature was selected since earlier work (10) indicated that pressure-induced crystallization could be achieved near the upper limit of hydrostatic pressure available at this temperature. That is, in the lower hydrostatic pressure ranges the viscosity of the melt could be determined but as the pressure is increased to around 24,000 p.s.i. the effect of pressure-induced crystallinity should be observed.

Figure 5, above, shows the apparent viscosity of polyethylene as a function of hydrostatic pressure. As the pressure is increased the apparent viscosity increases at a fairly constant rate up to a point somewhere between 18,000 and 24,000 p.s.i. At this point there is an abrupt increase in slope of the line; that is, the rate of increase of apparent viscosity with hydrostatic pressure increases rapidly in this region. The apparent viscosity is 14-fold greater at 24,000 p.s.i. than at atmospheric pressure.

Comparison of these data with those found for polystyrene shows that the melt viscosity of the polyethylene is considerably lower than that found for polystyrene at the lower hydrostatic pressures; also, that the point of rapid change in slope occurs at a lower value of hydrostatic pressure (about 9000 p.s.i.) for polystyrene as compared to polyethylene (about 18,000 to 20,000 p.s.i.). Thus, pressures requisite to cause pressure-induced crystallization must be reached to cause marked increases in the apparent viscosity of polyethylene.

The immediate industrial significance of the foregoing is that increased molding pressures on polyethylene will not have the very pronounced influence on viscosity that was shown to occur with polystyrene. A noticeable effect, nevertheless, will occur, but severe viscosity changes will not take place until very high pressure conditions of 18,000 p.s.i. or more are reached.

An explanation of the lower magnitude of viscosity change occurring with polyethylene can, as with polystyrene, be based upon structural configuration. This polymer has no large side groups to prevent it from assuming a somewhat ordered state when subjected to a compressive force. Thus the polymer will not build up viscosity at an abnormally large rate.

At very high pressure levels the ability to form an ordered configuration due to the lack of bulky substituent groups permits pressure-induced crystallization. Hence a sudden viscosity increase is found.

Conclusions

The following conclusions can be drawn from this investigation.

1) It is possible to measure the apparent viscosity of polymer melts subjected to controlled hydrostatic pressures that are independent of the driving force.

2) Hydrostatic pressure causes a marked increase in the apparent viscosity of polystyrene and polyethylene. A 135-fold increase in viscosity of polystyrene melts has been found at 18,000 p.s.i. hydrostatic pressure. A 14-fold increase in viscosity was found for polyethylene at 24,000 p.s.i. pressure.

3) These changes in viscosity are consistent with the current concept of the structures of these two polymers. The pendant benzene ring in polystyrene interferes with flow as the density is increased due to hydrostatic pressure. The apparent viscosity of polyethylene does not show as marked a pressure dependency due to its lack of pendant groups until pressures sufficient to induce crystallization are reached. At such pressures the formation of regular lattice structures prevents the independent motion of the individual chain molecules and the flow process must involve the common motion of large groups of chains.

4) The commercial practice of increasing molding or extruding

(*To page* 276)

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Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Three-dimensional photoelasticity. M. M. Leven. Prod. Eng. *28,* 135-38, 140 (July 1957). Plastic models of highly stressed parts are heated to a critical temperature, loaded, then slowly cooled with the loads still acting. The strains remain fixed in the model and careful cutting will not disturb them. A simple diffusion circular polariscope is used. The best materials available for three-dimensional frozen stress tests are the acid-cured epoxy resins. Suggestions are given for the casting cycle, for interpreting the model, for using the Tardy method of compensation for determination of fractional fringe orders, for determining interior stresses, and for the machining of complex models.

Technical progress in the rubber and plastics industries. Rubber J. *133,* 74-76 (July 20, 1957). Recent developments of the plastics industry are reviewed. These include: gloves lined with Vinylite, which are resistant to oils, gasoline, and acids; an inflatable polyethylene bottle with a valve which closes automatically; a Swiss installation of plastic pipe to transport milk for cheese manufacture; plastics munitions from France; plastics tools; a synthetic rubber of polyacrylic ester type which provides exceptional resistance to dry heat; a fast-acting stable silicone defoamer; a polyvinyl acetate resin emulsion which is mixed with concrete used for repair and resurfacing, replacing part of the water ordinarily used, producing bonds ten times stronger than those made with plain cement mortars; and a new polyethylene resin which produces unbreakable molded articles of greater rigidity, more wear resistant surfaces, and higher gloss.

Development of plastics and synthetic resin industries. S. D. Mahant, H. A. Shah, and K. K. Sarin. Research & Industry *2,* 117-21 (May 1957). A survey of the plastics industry in India and a forecast of probable expansion to meet future needs are presented.

We live in an age of plastics. South African Standards Bull. *10,* 194-98 (May 1957). The advantages of plastics are briefly reviewed. It is suggested that all plastics articles bear labels with the following information: 1) the manufacturer's name, the brand name, and the chemical name; 2) the temperature limits it will withstand without distortion; 3) the liquids and solids to which it is resistant (or nonresistant); and 4) the characteristics, application, and way of treating the particular type of plastic. A brief survey of the plastics industry in South Africa is included.

Materials

Pigments in polymer materials. J. F. Ambrose. Bell Lab. Record *35,* 246-50 (July 1957). Pigments are defined as "finely divided materials of an ultimate size greater than atomic or molecular dimensions, which are insoluble in the base material in which they are dispersed." Properties not originally present in the plastic may be added, or undesirable properties may be ameliorated or removed by the addition of pigments. The compounder may change the thermal and electrical conductivity, the magnetic susceptibility, the light absorption, the chemical reactivity, and the surface-dependent properties such as adsorbtivity by the addition of suitable pigments and fillers. Pigments act as a light screen to absorb ultra-violet radiation from sunlight extending the life of polyethylene telephone cable to nearly 20 years. Unpigmented cable in the same application lasts little more than 1 year. Pigments are used for color-coding, to dissipate the heat generated by potted components in use and released in curing, to reduce shrinkage upon cure, to improve abrasion resistance and tensile strength, and to make possible the extrusion of many polymer formulations that are otherwise intractable. Economy and processing ease are important secondary advantages.

Effect of fillers in epoxy resins. H. L. Parry and R. W. Hewitt. Ind. Eng. Chem. *49,* 1103-04 (July 1957). The effects of fillers on the properties of epoxy resins are reported.

Radiation chemistry leads to new products and processes. L. Franzke. Chem. Ind. Internationale No. 2, 60-61 (June 1957). Polymerization at temperatures below zero, graft polymerization, vulcanization by radiation, and effects of radiation on polymerized plastics are reviewed.

m-Xylylenediamine polyamide resins. E. F. Carlston and F. G. Lum. Ind. Eng. Chem. *49,* 1239-40 (Aug. 1957). *m*-Xylylenediamine forms crystalline polymers from dibasic acids of odd carbon number and amorphous polymers from dibasic acids of odd carbon number. The melting points of polymers of *m*-xylylenediamine and several dibasic acids fall between the melting points of corresponding polymers of pentamethylenediamine and hexamethylenediamine. The reaction characteristics of this new diamine are typical of aliphatic diamines and not of the true aromatic diamines. A comparison of poly(*m*-xylylene adipamide) and of poly(hexamethylene isophthalamide) shows that the *m*-xylylenediamine polymer crystallizes readily on annealing, while the polymer of reverse structure re-

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mains amorphous even on long annealing, and is very difficult to crystallize. The crystalline form of poly(*m*-xylylene adipamide) has a melting point of 243° C. and an A.S.T.M. heat distortion temperature of over 200° C. These data indicate that *m*-xylylenediamine, a new diamine, has great promise for producing superpolyamides for use in fibers, films, and molding materials.

Molding and fabricating

Some aspects of the shaping of acrylic and PVC rigid sheet. J. M. J. Estevez and D. C. Powell. Plastics Inst. Trans. & J. *25*, 80-90 (Apr. 1957). Methods of heating and shaping acrylic and polyvinyl chloride sheets are described.

"Truprocess" castings for plastics dies. A. Torry. Plastics Inst. Trans. & J. *25*, 125-36 (Apr. 1957). The different techniques for molding items by the investment process and by sand molds are described.

Combustible-dust hazards in the plastics industry. S.P.I. Committee on Fire Prevention. 4pp. (1957). Combustible-dust hazards of plastics molding and extrusion compounds, and resins are described. The violence of the dust explosions is dependent on the concentration, particle size, and degree of confinement. Precautions for prevention of dust explosions are described.

Studies on the extrusion of molten plastics (2nd report). T. Yoshida, K. Hayashida, K. Kobayashi, and H. Tanaka. Chem. Eng. (Japan) *21*, 366-73 (June 1957). A graphical representation of screw characteristics of an extruder is made. It is assumed that the material does not slip on the surface of the screw and barrel but flows in accordance with the Rabinowitsch rheological equation.

Applications

Metallic and plastic implants in the human body. E. Matthews, H. J. Axon, and B. Hedegard. Research *10*, 235-40 (June 1957). The necessary mechanical properties of materials used as implants in the human body and the chemical effects of the materials upon the biological system are discussed. Polyethylene tubing is used in brain surgery, for drainage of inflamed tissues, and replacement of bladders and blood vessels. Teflon is being used experimentally for reconstructions of intrathoric trachea and aorta. Acrylic plastics are used for shoulder joints, prostheses, skull bones, facial restorations, thigh bones, shin bones, jaw bones, and teeth. Nylon 8 film is used as a surgical dressing and nylon 610 as suture material. The bio-mechanical problems of several prostheses are considered.

Plastic piping—8 years later. W. D. Greathouse and R. L. McGlasson. Oil and Gas J. 55, 106-12 (Aug. 12, 1957). Three types of plastics for oil-field use are discussed: extruded plastics, glass-reinforced plastics, and plastics-coated metal pipes. The preferred use for each is shown, based on maintenance cost, deterioration in service, temperature-strength characteristics, and creep characteristics.

Epoxy resin replaces polyester resin, improves magneto coil production. C. H. Carter. Insulation *3*, 56-7 (July 1957). The use of a new flexible epoxy resin has resulted in a 50% increase in production of resin-encapsulated magneto coils without increase in the number of molds, because of shorter production time and a sharply decreased amount of rejects.

Encapsulation of electronic circuits. R. Calicchia. Electronic Design *5*, 22-25 (Aug. 1, 1957). Casting resins for encapsulation of electronic equipment at frequencies up to 240 mc. were evaluated.

Plastic tableware. Pottery Gazette *82*, 1021-25 (Aug. 1957). Melamine plastic dishes are compared with English pottery. The plastic dishes are lighter in weight than bone china or earthenware, do not chip, are much less fragile, stain to approximately the same extent, show approximately the same bacteria count when washed under identical conditions, and cost approximately the same as white bone china in England (about twice the price of earthenware).

Properties and performance of reinforced polyester plastics in the chemical industry. R. E. Gackenbach and D. G. Estey. Corrosion *13*, 74-80 (Aug. 1957). Some of the basic properties of polyesters which must be considered by designers and fabricators are discussed. The use of reinforced polyester resins for alum evaporators, stacks, dryer trays, filter troughs, and filter press plates and frames is discussed in detail.

Plastics in building. Part 5. Plastics in today's and tomorrow's building. C. H. Topping. Practical Builder *22*, 132-35 (Aug. 1957). The developments that look like "sure bets" to receive increasing attention in building applications are discussed. Various combinations of properties that make for better building products are considered. The cost factor is explored briefly. Many new uses of plastics in the building industry are predicted.

Glass fibre-reinforced plastics for vehicle bodies. Machinery Lloyd, Overseas ed., *29*, 79-80 (July 20, 1957). The production in England of commercial vehicle bodies of all types from glass fiber-reinforced plastics is described. A wet lay-up contact molding technique, using as reinforcements chopped strand mat, is employed. This form of construction offers the advantages of light weight, strength, and an attractive noncorrosive finish.

Properties

Analysis of the thermal properties of plastics laminates, cores, and sandwich panels. R. F. Trapp. WADC Tech. Report 56-543. 12 pp. (Jan. 1957). The thermal properties of plastics laminates, cores, and sandwich panels are presented by grouping data from WADC Technical Reports 54-306 Parts I and II into sets, arranged according to the types of resin used in their construction. Curves are presented which are representative of the resin types for

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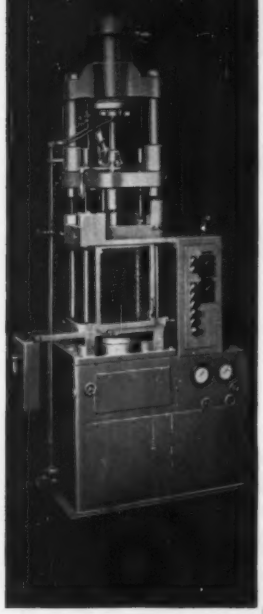

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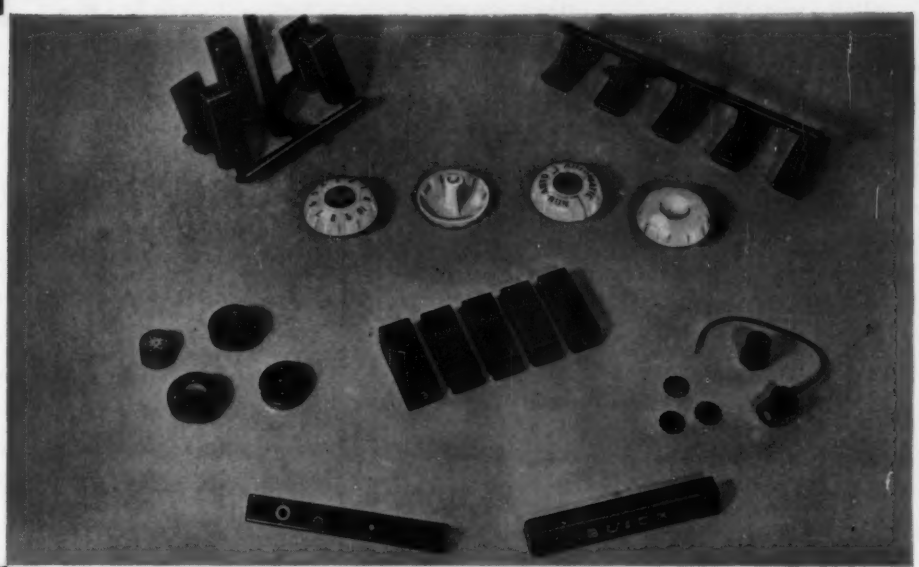

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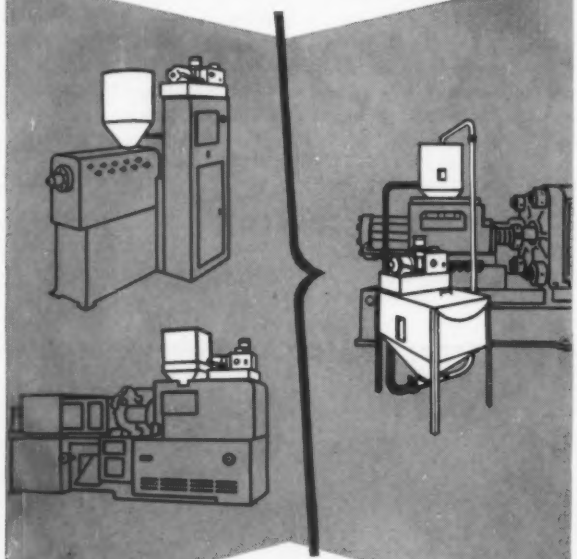

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each thermal property. The scatter of data about these mean curves varies from ±10% to ±40%. Available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

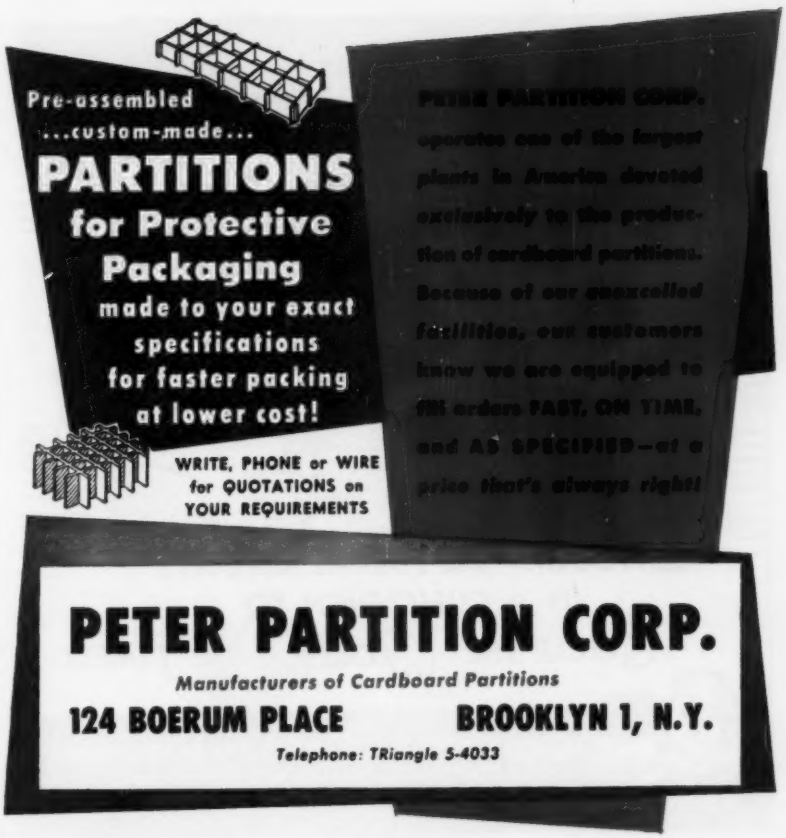
How to predict performance of rubber vibration isolators. W. W. Soroka. Prod. Eng. *28,* 141-45 (July 1957). A new method of analysis accounts for creep of visco-elastic materials such as rubber, nylon, rayon, and fibrous materials. Designs with lower transmissibility and better performance under shock may result.

How to find design allowables for reinforced plastic laminates. E. L. Strauss. Aviation Age *28,* 72-77 (Aug. 1957). A program for finding all the necessary plastics laminate design allowables for use in aircraft and missile applications is described.

Testing

Determination of monomeric epsilon-caprolactam and moisture in nylon-6. H. H. Schenker, C. C. Casto, and P. W. Mullen. Analytical Chem. *29,* 825-29 (May 1957). A rapid procedure for the simultaneous determination of E-caprolactam monomer and moisture in nylon-6 flake and yarn is described. They are separated from the sample by vacuum extraction at 200°C., the monomer and part of the moisture being condensed in a water-ice fold trap. The monomer is determined by refractive index in an aqueous dilution of the condensate, while moisture is obtained by difference. The procedure requires less than 3 hr. as compared to the 24-hr. water-extraction procedure for the determination of total water-extractable material and, when used in conjunction with the water-extraction procedure, it furnishes an estimate of the dimer content plus any low molecular weight, water-soluble, linear molecules present in the polymer.

Evaluation of a microhardness tester. R. E. Morris and J. M. Holloway. A.S.T.M. Bulletin No. 222, 45-50 (May 1957). The proposed ISO microhardness tester



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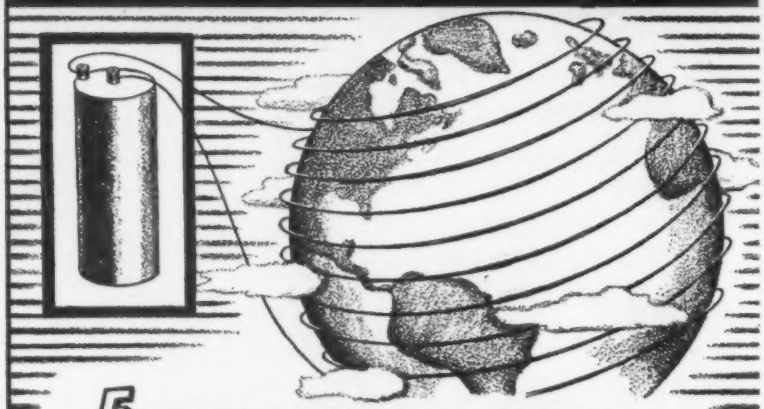

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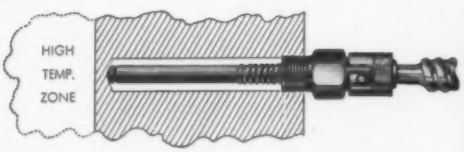

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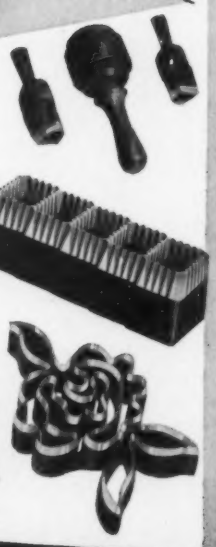

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The testing of polyvinyl chloride electrical formulations. G. W. Ashworth, J. R. Darby, W. E. Koerner, and R. H. Munch. A.S.T.M. Bulletin No. 222, 38-41 (May 1957). A new type of test is described for measuring the electrical resistivity of plastics insulation compounds during water immersion. Data are presented on polyvinyl chloride formulations made with various plasticizers. The correlation-data presented show that results obtained using molded electrode test specimens permit a good estimate of expected performance in wire extrusion. The small sample size and the relatively simple equipment requirements recommend this technique for research and control tests.

A method for measuring surface flammability of materials using a radiant energy source. A. F. Robertson, D. Gross, and J. Loftus. A.S.T.M. Proc. *56*, 1437-53 (1956). There has been a need for a relatively simple yet sufficiently severe and reproducible method for measuring the surface flame spread properties of materials. A test method is described which meets this need. The method employs a radiant heat source consisting of a 12 by 18-in. panel in front of which a 6 by 18-in. specimen of the material being tested

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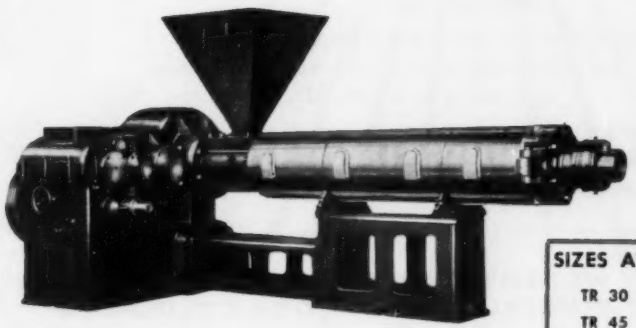

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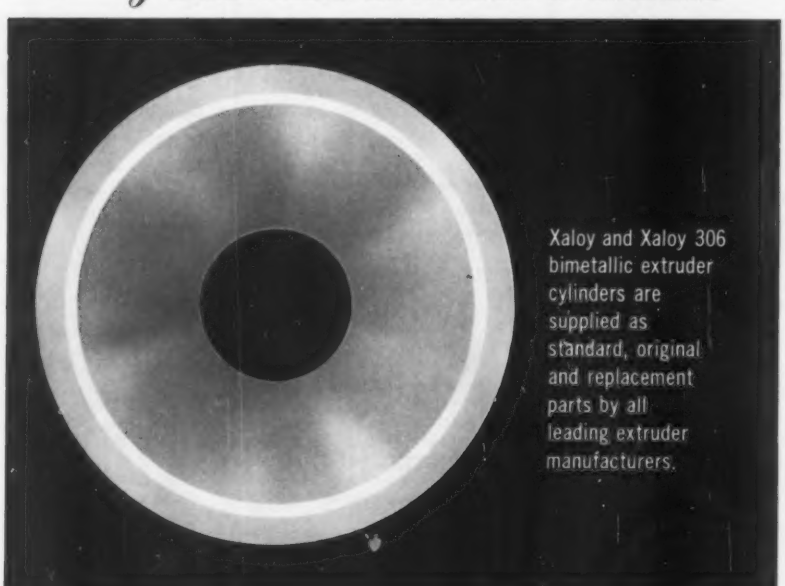

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is mounted. The specimen orientation is such that ignition is forced near the top and the flame front progresses downward. The rate of progress of the flame front together with a factor involving the rate of heat generation by the material under test are combined by means of an empirical relationship to provide a flame spread index for the material. It is demonstrated that the test method is relatively insensitive to changes in ambient variables and modifications in mechanical adjustment. The classification of materials with respect to flammability follows an order consistent with their behavior during fires.

Radiography of polythene in submarine cable work. D. C. Shotton. Brit. Communications & Electronics 4, 493-95 (Aug. 1957). A compact, low-voltage X-ray set for the radiography of joints in the polyethylene dielectric of coaxial telephone cables for submarine use is described.

Publishers' addresses

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.
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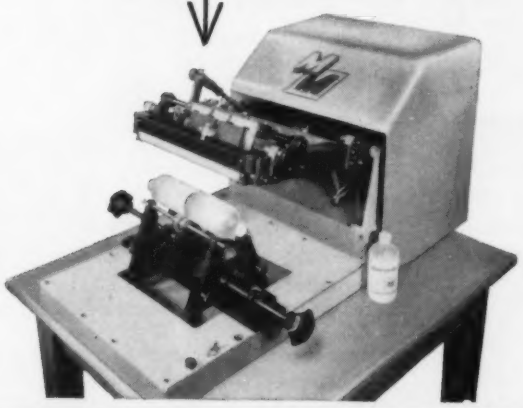

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Resins. O. W. Burke, Jr. U. S. 2,797,207-8, June 25. Dienic resimers of dienic polymers.

Stabilizers. H. M. Hutchinson and K. Stevens (to Distillers). U. S. 2,797,209, June 25. Zinc sulfide suspension stabilizers in styrene polymerization.

Resin. O. W. Burke, Jr. U. S. 2,797,210, June 25. Polybutadiene reaction products from organo free radical mass catalysis.

Foamed resins. F. A. Carlson, Jr. (to Monsanto). U. S. 2,797,433, July 2. Extruded polystyrene foam.

Panel. E. Winer (to National Plastic Products). U. S. 2,797,447, July 2. Molded panel.

Valve assembly. B. Edwards (to Illinois Tool). U. S. 2,797,703, July 2. Plastic grease fittings.

Containers. M. A. Orlines (to Rheem Manufacturing). U. S. 2,797,843, July 2. Seaming plastic interlined containers.

Porous metal. P. P. Love (to Glacier Metal). U. S. 2,798,005, July 2. Porous metal bearing containing polytetrafluoroethylene.

Coatings. G. N. Bruxelles and D. K. Lesser (to Hercules). U. S. 2,798,014-5-6, July 2. Resinous metal coatings.

Reinforced plastic. E. H. Balz, L. F. Ornella, and J. D. Villwock (to L. O. F. Glass Fibers). U. S. 2,798,020, July 2. Fibrous glass reinforced resinous product.

Polymers. A. N. Roper (to M. W. Kellogg). U. S. 2,798,052, July 2. Polymers prepared by pyrolyzing 1,4-dimethyl aryl compounds.

Polymers. H. P. Brown (to B. F. Goodrich). U. S. 2,798,053, July 2. Carboxylic polymers.

Cellular products. E. Simon and F. W. Thomas (to Lockheed). U. S. 2,798,054, July 2. Cellular phenolic resin products.

Resin. W. A. Barber and H. Z. Friedlander (to American Cyanamid). U. S. 2,798,058, July 2. Compositions comprising a polymer of acrylamide and an organic acid.

Resin. D. C. Guth and E. J. Kerle (to American Cyanamid). U. S. 2,798,059, July 2. Compositions of an acrylonitrile polymer and an N-(2-cyanoethyl) acrylamide.

Polymerization. W. L. Rawitzer, H. J. Stern, and L. E. Shadbolt (to Dental Fillings). U. S. 2,798,060, July 2. Polymerization of acrylic esters.

Graft copolymers. H. W. Coover, Jr. and N. H. Shearer, Jr. to (Eastman Kodak). U. S. 2,798,061, July 2. Graft copolymers containing N-acrylyl substituted nitrogen heterocyclic components.

Polymers. L. L. Contois, Jr. (to Monsanto). U. S. 2,798,062, July 2. Heteropolymers of styrene and alkyl esters of maleic acid.

Polymers. W. F. Fowler, Jr. and R. J. Hellmann (to Eastman Kodak). U. S. 2,798,063, July 2. Interpolymers of vinylpyridines, acrylic esters, and acrylonitrile, and hydrosols thereof.

Molding. E. Eynard. U. S. 2,798,256, July 9. Injection molding machine.

Extrusion. J. Allen, D. W. Browne, and H. Samuel (to British Celanese). U. S. 2,798,258, July 9. Process of extruding sheets.

Filament. E. E. Magat and D. R. Strachan (to Du Pont). U. S. 2,798,283, July 9. Condensation polymer filament.

Shoe. F. A. Muller. U. S. 2,798,312, July 9. Plastic shoe.

Hose. M. M. Kahn (to Acme-Hamilton). U. S. 2,798,508, July 9. Flexible plastic hose.

Conduit. J. H. Martin and E. S. Reid (to Sonoco Products). U. S. 2,798,510, July 9. Reinforced plastic conduit.

Cutting machine. W. Leirer. U. S. 2,798,548, July 9. Cutting machine for cutting extruded plastics.

Leather treatment. E D. Brown, Jr. (to General Electric). U. S. 2,798,858, July 9. Treatment of leather with methylpolysiloxanes.

Resins. W. L. Bruce (to Goodyear). U. S. 2,798,859, July 9. Compositions of magnesium oxide and elastomeric isocyanate-modified linear polyesters.

Coating. G. H. Segall and J. L. Cameron (to Canadian Industries). U. S. 2,798,861, July 9. Coating of diphenylolpropane - epichlorohydrin and styrene-acrylic ester-acrylic acid copolymer.

Polymers. W. M. Thomas (to American Cyanamid). U. S. 2,798,864, July 9. Ternary polymers of acrylonitrile, a 2-alkenyl dihydroxyalkanyl ether, and an alkyl acrylate.

Resins. F. W. Banes, J. F. Nelson, and R. G. Hoyt (to Esso). U. S. 2,798,865, July 9. Petroleum resins.

Copolymers. A. L. Miller (to Celanese). U. S. 2,798,868, July 9. Copolymers of improved homogeneity.

Extrusion. A. T. Widiger and F. R. Lennox (to Dow). U. S. 2,799,047, July 16. Rotary hopper for extruders.

Encapsulating. F. E. Stirn and A. S. Taylor (to American Cyanamid). U. S. 2,799,048, July 16. Die roll for plastic encapsulating machine.

Molding. G. C. Wilson (to Armstrong Cork). U. S. 2,799,049, July 16. Injection molding machine.

Molding. B. J. Traycoff. U. S. 2,799,050, July 16. Molding apparatus.

Resins. H. A. Hampton and R. Hurd (to Imperial Chemical). U. S. 2,799,663, July 16. Resinous polyhydric alcohols.

Polyesters. J. G. Drewitt and J. Lincoln (to British Celanese). U. S. 2,799,664-5-7, July 16. High linear polyesters.

Polycarbonates. J. R. Caldwell (to Eastman Kodak). U. S. 2,799,666, July 16. Linear polycarbonates.

Polymers. A. W. Anderson and N. G. Merckling (to Du Pont). U. S. 2,799,668, July 16. Polymers of ethylene and bicyclo(2,2,1)-2-heptanes.

Polymers. A. O. Zoss (to General Aniline). U. S. 2,799,669, July 16. Polymers of vinyl alkyl ethers.

Extrusion. H. J. Grow and W. D. Paist (to Celanese). U. S. 2,799,896, July 23. Sheet extrusion.

Polymers. I. Barnett and S. E. Zager (to Johns-Manville). U. S. 2,799,915, July 23. Thermal modifications of polyacrylonitrile.

Electrodeposition. H. E. Graham, Jr. (to Du Pont). U. S. 2,800,447,

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July 23. Control of pH in electrodeposition of polytetrafluoroethylene.

Polyurethanes. A. L. Miller (to Celanese). U. S. 2,800,464, July 23. Addition of acid to half polyurethane producing reaction.

Copolymers. J. F. Nelson, R. Leary, and L. M. Welch (to Esso Research). U. S. 2,800,465, July 23. Two-stage manufacture of copolymers.

Silanes. L. A. Haluska (to Dow Corning). U. S. 2,800,494, July 23. Unsaturated fluorocarbon silanes.

Film. G. F. Nadean and C. B. Thompson (to Eastman Kodak). U. S. 2,801,191, July 30. Composite film.

Resins. A. H. Greer (to Permutit). U. S. 2,801,222-3-4, July 30. Anion exchange resins.

Polyethylene. J. Harding (to Carbide and Carbon). U. S. 2,801,225, July 30. Odor-inhibited polyethylene.

Resins. H. P. Wohnsiedler (to American Cyanamid). U. S. 2,801,226, July 30. Resin compositions.

Resins. J. M. Goppel (to Shell). U. S. 2,801,227, July 30. Glycidyl ethers of polyhydric phenols.

Resins. H. Starck and F. Schlenker (to Chemische Werke Albert). U. S. 2,801,228, July 30. Epoxy resins.

Polyethers. R. L. De Hoff and H. L. Parry (to Shell). U. S. 2,801,-229, July 30. Curing glycidyl polyethers.

Resins. G. L. Fraser and R. M. Dickey (to Monsanto). U. S. 2,801,-230, July 30. Polyisocyanate-cyclic urea derivative reaction products.

Polyurethanes. J. R. Caldwell (to Eastman Kodak). U. S. 2,801,231, July 30. Linear polyurethanes from alkyl diurethanes.

Resins. T. J. Suen and G. H. Hicks (to American Cyanamid). U. S. 2,-801,232, July 30. Diepoxy resins.

Resins. L. M. Minsk and C. C. Unruh (to Eastman Kodak). U. S. 2,801,233, July 30. Ethylene-vinyl cinnamate copolymers.

Cellulose esters. R. Clevy and J. Robin (to Societe "Rhodiaceta"). U. S. 2,801,237, July 30. Continuous esterification of cellulose.

Cellulose isobutyrate. C. J. Malm and L. W. Blanchard, Jr. (to Eastman Kodak). U. S. 2,801,238-9-40, July 30. Cellulose isobutyrate manufacture.

Extrusion. E. K. Bauer (to Ameri-

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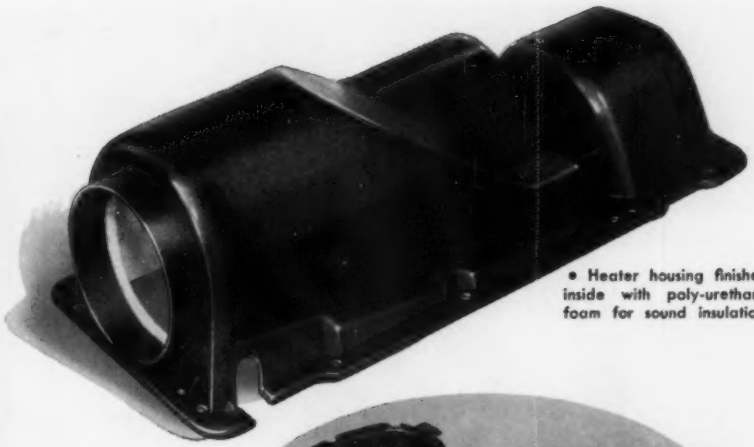
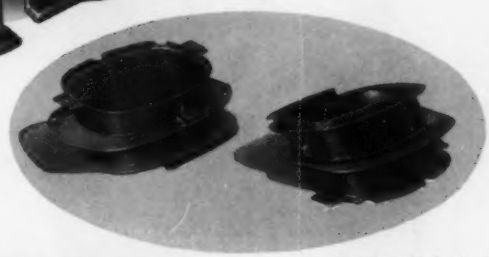


• Heater housing finished inside with poly-urethane foam for sound insulation.



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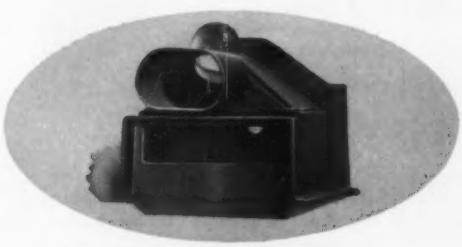
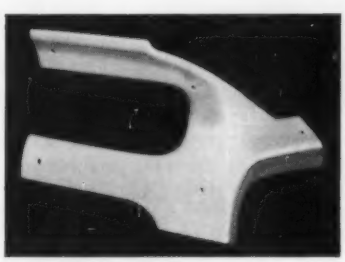


• Housing for air conditioning system.



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can Viscose). U. S. 2,801,440, Aug. 6. Extrusion apparatus.

Molding. H. M. Wadsworth. U. S. 2,801,441, Aug. 6. Molding internally threaded tubing.

Molding. E. P. Moslo. U. S. 2,801,-442, Aug. 6. Molding machine.

Polyethylene. L. E. Wolinski (to Du Pont). U. S. 2,801,446-7, Aug. 6. Treating polyethylene articles with halogens.

Container. J. F. Anderson and L. F. Fiedler (to B. F. Goodrich). U. S. 2,801,648, Aug. 6. Metal container bonded with a polyester-urethane resin.

Resins. D. E. Baldwin and R. H. Runk (to Westinghouse). U. S. 2,-801,672, Aug. 6. Resin-bonded fire-resistant laminates.

Sheet. I. Swerlick (to Du Pont). U. S. 2,801,674, Aug. 6. Permeable sheet material.

Tubes. D. A. Rogers, Jr. and N. C. Foster (to Westinghouse). U. S. 2,-801,945, Aug. 6. Reinforced polyester barrier tubes.

Resins. R. B. Spacht (to Goodyear). U. S. 2,801,981, Aug. 6. Polymerized tertiary alkylated allyl phenols.

Resin-forming composition. R. L. Morgan and J. J. Padbury (to American Cyanamid). U. S. 2,801,-984, Aug. 6. Soil-stabilizing composition.

Resins. A. Fischer and M. Nowak (to Heydon). U. S. 2,801,988, Aug. 6. Stabilized halogen-containing vinyl resin compositions.

Resins. A. G. Farnham (to Carbide and Carbon). U. S. 2,801,989, Aug. 6. Glycidyl polyether of a polyphenylol.

Resins. N. V. Seeger and T. G. Mastin (to Goodyear). U. S. 2,801,-990, Aug. 6. Elastomeric isocyanate-modified polymers.

Copolymers. R. M. Hedrick (to Monsanto). U. S. 2,801,991, Aug. 6. Copolymer of ethylenesulfonyl fluoride and acrylonitrile.

Polyurethane. S. J. Groszos and E. K. Drechsel (to American Cyanamid). U. S. 2,802,022, Aug. 6. Method of producing a polyurethane.

Molding. C. K. Marklew (to Alfred Herbert). U. S. 2,802,084, Aug. 6. Molding machine.

Plastic treatment. F. N. Rothacker (to Modern Plastic Machinery). U. S. 2,802,085, Aug. 6. Treating plastic webbing.

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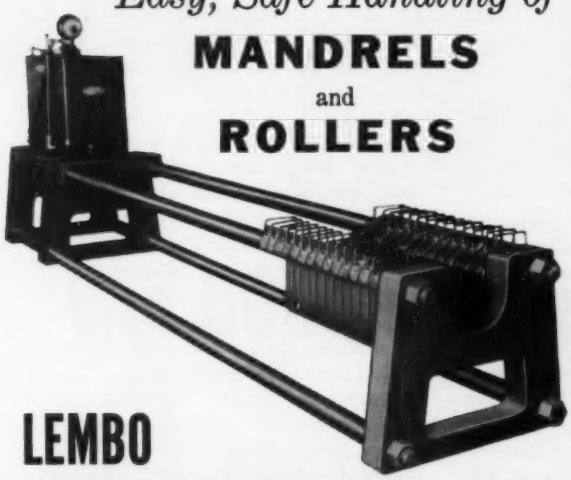

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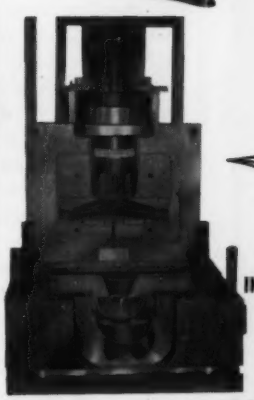

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Extruders designed for heatless operation

The theory of adiabatic operation of extruders has been known for some time. Essentially it consists of working the plastic so intensively with the screw that no heat need be supplied along the barrel. (The term adiabatic implies also that no heat is lost to the surroundings, but for practical purposes this is not a necessity.) The Alpine line of extruders has been designed and tested for heatless operation. In general, screw speeds are very high—in the 400 to 1500 r.p.m. range—and so are drive horsepowers. Some heat is usually needed on the die head, since there is very little viscous working in that area. Low-density polyethylene has been processed at 45 p.p.h. from a 1.4-in., L/D = 12, screw with a power input to the drive of 6.0 hp. Polyethylene rate with the 2.6-in. model is 154 p.p.h. All the common thermoplastics, including nylon, have been run in these machines. The photo shows the 1.4-in. machine set up to make blown film, which it is capable of producing in widths up to 27 inches.

Advantages claimed for heatless extruders are: 1) mechanical and instrumental simplicity: no speed reduction gears are needed, and since barrel temperature is self-regulating, no heaters, pyrometers, or coolers are needed. 2) High output for extruder size cuts investment, saves space. 3) Excellent power economy. 4) Better control of extrudate dimensions. *U.S. Representatives: Lukens Chemical Co., 227 California St., Newton 58, Mass.*

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

Alpine 1.4-in. extruder set up to make blown film, which it can produce in widths up to 27 inches

Induction heated extruders

For the first time, an induction heating system for screw extruders has been demonstrated. A 4.5-in. extruder (L/D = 20) was brought to operating temperature from a cold start in 20 min. with less than ¼ the energy required by resistance heaters, it is claimed. Induction heating works by setting up eddy currents in the metal parts of the extruder (barrel *and* screw). The resistance of the metal to these currents causes heat to be generated in the metal, as in any resistance heating element. Thus instead of conducting the heat in from the outside surfaces, the heat is generated relatively uniformly throughout the mass. Advantages: faster heating, much lower heat losses to the surroundings, and elimination of large temperature differences and hot spots. The system can be applied to a wide range of extruder sizes and is useful for both plastics and rubbers. It can also be adapted to existing machines where faster response is wanted. *Hale & Kullgren, Inc., 613 E. Tallmadge Ave., Akron 9, Ohio.*

Intermediate intensive mixer

The Model 1-B Banbury-type intensive mixer is intended for small production or major laboratory work. Chamber capacity is 5.2 gal., enough to accommodate working batches of about 25 to 50 lb. (depending on the density of the material. Design features are those of the larger mixers in the line: anti-friction bearings, split end frames, "spiral-flow" sides for high heat transfer rates, and the compound-type drive that provides high speeds and power in small space. Discharge door is motorized, working surfaces are chrome-plated. Drive power is optional, but about 50 hp. *Stewart Bolling & Co., 3190 E. 65th St., Cleveland 27, Ohio.*

High-energy particle machine

A linear electron accelerator designed for research and limited commercial processing, can deliver electrons at from 2 to 10 m.e.v., or, indirectly, X-rays or neutrons. At its full power of 4 kw., the accelerator can deliver up to 3000 megarad-lb./hr., with a penetration (in typical plastics) of about 0.7 in. from one side or 1.6 in. from two sides. Most common sheet widths can be processed in a single pass at the proper rate. Because of the deep penetration, multiple thicknesses of thin sheets are more practical to process than single thicknesses. Machine can be purchased or leased. *Applied Radiation Corp., Walnut Creek, Calif.*

Automatic injection machine

The HPM Model 200-H-6/8 is designed to shoot 6 oz. of GP polystyrene per stroke or 8 oz. with prepacking, and has a plasticating capacity of about 80 lb./hr. Top injection pressure is 20,000 p.s.i., maximum rate of injection is 11.2 cu. in./sec. The 30-hp. hydraulic system develops up to 200 tons of clamping force,

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3. Inexpensive molds, lower price of press, and fast cycling keep costs to a minimum.

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Hydraulic Press automatic injection molding machine Model 200-H-6/8 has a dry-cycle time that ranges from 4.0 to 5.1 seconds

with a stroke up to 15 in., and a fast-closing speed of 14 in./sec. Daylight opening may be as large as 25 in., depending on mold thickness, which may be as little as 6 inches. Dry-cycle time ranges from 4.0 to 5.1 sec., depending on stroke and pressure requirements. Special features include an overhead oil tank for cleanliness, centralized clamp controls, separate pilot circuit for shifting valves, and full hydraulic clamp. Maximum mold width and height (or vice versa) is 15 by 26 inches. Automatic cycle controls, low-pressure mold-closing protection, weigh feeder, extra-high injection speeds (60% more), and multiple-nozzle arrangement for runnerless molding are optional extras. *The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.*

Blown film slitter, winder; film inspector

A line of units that can slit and open extruded film tubing in widths from 10 in. (opened) to 72 in. has been announced by Hobbs Mfg. Co. The machines slit the tube, unfold it to a flat sheet, and wind it in a continuous operation. Winding is accomplished by a controlled-tension winder at the take-off end.

The same company is also offering a machine that will unwind, meter, and rewind flexible plastic film and sheeting. An inspection table over which the sheeting passes facilitates examination for defects. Metering is done under zero tension to avoid inaccuracies and waste due to stretching. Available for sheeting widths up to 60 in., the d.c.-driven, roll-fed inspection unit can be stopped or reversed for rechecking. *Hobbs Mfg. Co., 26 Salisbury St., Worcester, Mass.*

Heat sealer for molded parts

In the past, molded parts could be welded together only by the hot-gas gun method which requires much hand labor. The Cosomatic Sealer welds polyethylene parts automatically at rates up to 50 parts per minute. A built-in vacuum system facilitates vacuum-holding of parts, which are fed into the holding fixtures by hand. Once in, the machine takes over to control the heat and pressure for fusion. Parts to be sealed must have parallel faces so that continuous contact is achieved at the surfaces to be joined. While principles are common to all the units, each is designed to do the best job on the customer's parts. *Cosom Engineering Corp., 6012 Wayzata Blvd., Minneapolis 16, Minn.*

Cosom heat sealer welds polyethylene parts automatically at rates up to 50 pieces per minute

Bending tool for nylon tubing

The Permabender, which forms permanent bends in nylon pressure tubing, should be useful in fitting the rather stiff, resilient tubing into instrumentation setups where preformed lines are needed. The tool is essentially an electrically heated mandrel in the shape of a 90° segment of a truncated cone. Semicircular grooves following the conical surface are kept at the ideal forming temperature. Tubing to be formed is held in the heated groove for 10 to 20 sec., then water-quenched for the same time. Five grooves accommodate the five standard sizes from ⅛ to ⅜ inch O.D. *The Polymer Corp. of Pennsylvania, 2140 Fairmont Ave., Reading, Pa.*

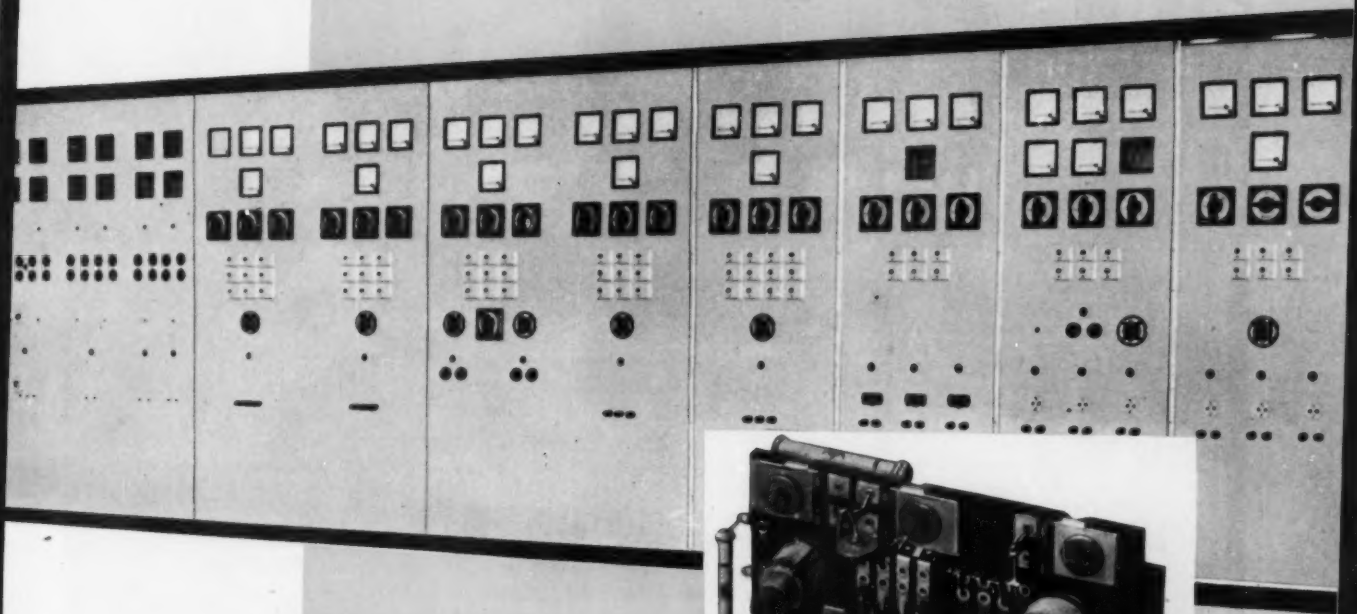
High-pressure control valves

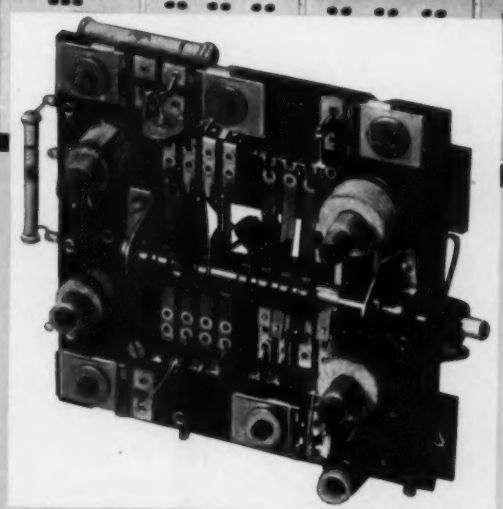
A line of 2- and 3-way control valves, designed for use in plastics molding and similar equipment, are rated for 6000 p.s.i. Bodies of valves are machined from aluminum-bronze bar stock; this combination of material and manufacturing method is claimed to eliminate valve body distortion under the highest working pressures. The valves, available in sizes from ½- to 2-in. NPT, are diaphragm-actuated by 40-p.s.i. air. All are offered in normally-closed or normally-open construction. Stems are stainless-steel sleeved and seats are stellite faced for accurate alignment and low wear over long periods. Both stems and seats are easily changed. *Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.*

Mixing head for resin pumps

A new mixing head for use with the makers Series 500 Triplematic pumps for metering and mixing two-component resin systems allows small shots of resin to be

TROISDORF PLASTICS





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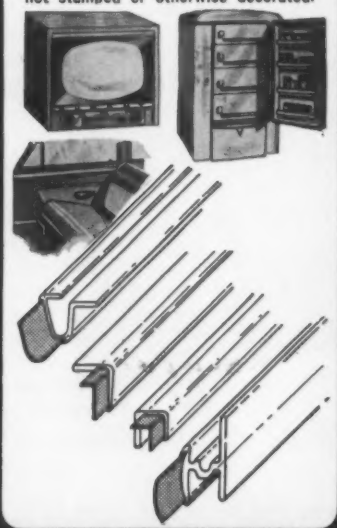

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pumped at a lower rate than did earlier mixing chambers. It also improves the quality of mixing and reduces the lag time between mixing and delivery. The new head, which is more accessible for thorough cleaning than the old, can be easily installed on all 500 Series models. It is jacketed for heating or cooling, can be resin purged in five seconds. *H. V. Hardman Co., Belleville, N. J.*

Improved cable puller

A heavy-duty caterpillar capstan features a tread that grips not only across but also around the wire or cable being pulled. When pressure is applied the treads conform to the shape of the cable, for any wire in the diameter range from 5/16 to 5 inches. A regulating valve adjusts the pressure of each pair of treads to any value up to 400 lb., resulting in a 17-tread-pair pulling capacity of up to 5000 pounds. The capstan can be belted for top cable speeds of 100, 200, or 300 ft./min.; other speeds are available. *Davis-Standard, Mystic, Conn.*

Circulating liquid heater

Offered as a means of heating injection molds, the IMS Model 9000 liquid circulating heating unit is similar in design to an earlier model, but is rated for 9 kw., twice the capacity of the smaller model. Two 4.5-kw. elements are used under separate control. Heating medium is circulated by a ½-hp. pump, thermostat range is 150 to 550° F., and the circulator occupies a 28-in. cube. It is conveniently mounted on casters. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

250 p.s.i. sheet-forming machine

The Pressure-Vac machine, in addition to forming sheets by the usual vacuum method, can apply up to 17 atm. positive pressure in forming. This, in combination with the machine's direct-contact heating system, makes it possible to form oriented polystyrene and polyester, linear polyethylene, cast acrylic, rigid PVC, and nylons—materials ordinarily difficult to form. One of these, Mylar, has good mechanical properties over the temperature range from deep freezing to cooking; thus Pressure-Vac may open the way to economical cooked-in-the-package frozen foods.

Pressure-Vac forming machine can form oriented polystyrene, polyester, linear polyethylene, etc.

The direct-contact heating system is claimed to heat faster with greater efficiency than the usual radiant heaters. Heater area is 2 by 2 ft., maximum forming area is 23 by 23 in., maximum forming depth is 6 in., operating temperature range is from 100 to 500° F. Four timers control the cycle, and the machine is well instrumented. Heater load is 60 amp. at 220 v., while the vacuum pump draws 3.2 amp. and the hydraulic system draws 20 amperes. The air compressor may be from 2 to 5 hp. The machine is fed manually from rolled sheet material. Overall dimensions are: width, 76 in.; depth, 70 in.; height, 89 inches. *The Auto-Vac Company, 1984 State St. Ext., Bridgeport, Conn.*

Granulator, hopper-loader combination

Many molding materials must be dried before molding. With such materials, and/or on jobs where the regrind percentage is heavy, drying costs can be reduced and plasticating capacity maximized if scrap is ground and returned to the machine while still hot. This

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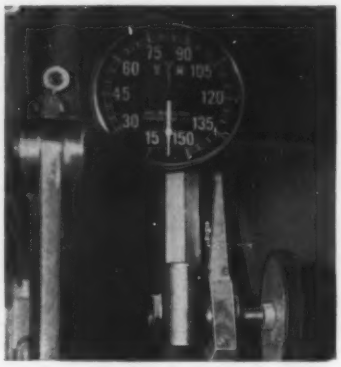
A Tachometer with a Friction Contact Wheel



Like other Jones Tachometers, the Surface Speed Indicator gives accurate, dependable and continuous readings of machine speed in RPM's, YPM's or FPM's. Only the surface indicator can be engaged or disengaged at will by merely dropping or lifting a friction wheel suspended in a bracket over the work or revolving part.

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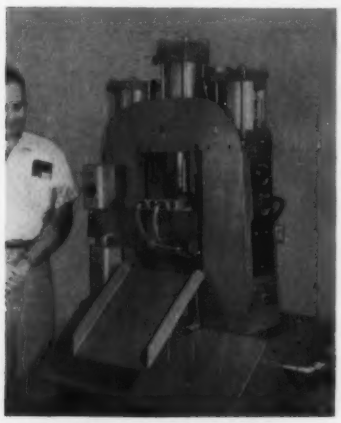
Press for short-run and lab work

The Automite A-10 is a 10-ton compression press with manual, semi-automatic, and fully automatic controls designed especially

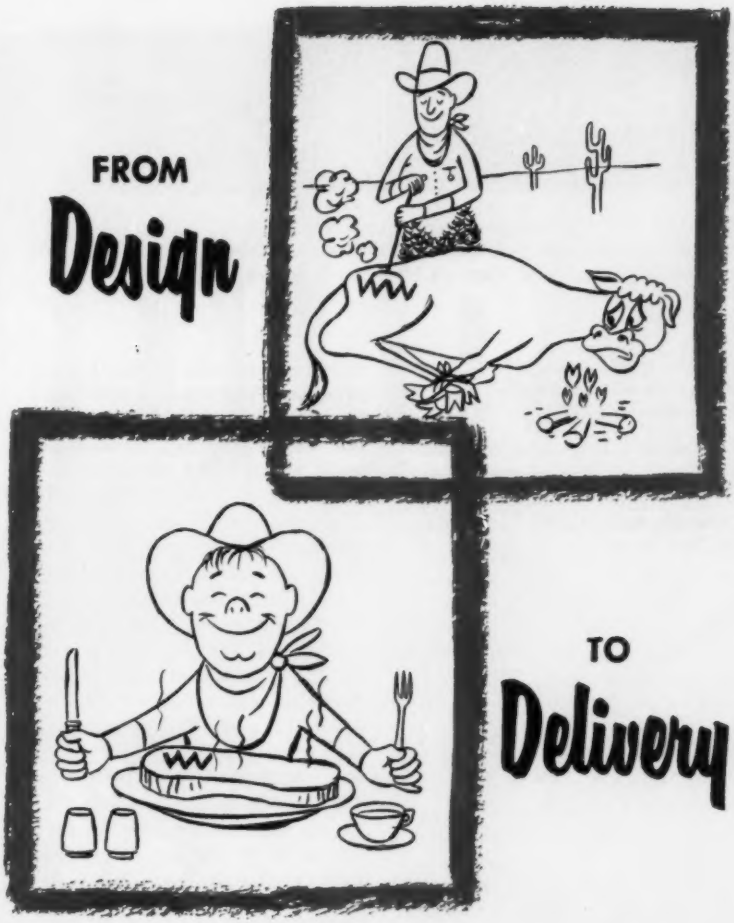


Automite A-10 compression press for lab work

"to solve the short-run problem." The machine depends for power on existing shop air supply, and requires 80 to 100 p.s.i. air. At 80 p.s.i. air pressure, pressures up to 20,000 p.s.i. on the ram can be developed. Stroke is 6 in., platen areas 5 by 6 in. All parts are quickly accessible for service; electrical controls are all mounted on a single panel board, to facilitate fast changes. *Automatic Molding Machine Co., 3201 Exposition Pl., Los Angeles 18, Calif.*

Lining for tumbling barrels

Visibility, ease of cleaning, and long-wearing qualities are improved by orange-colored vinyl linings that replace the former black linings used on this maker's barrels. Linings resist abrasion, oils, and many chemicals. *Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10, Ohio.*



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Books & Booklets

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"Modern Plastics Encyclopedia Issue—September 1957"

The annual edition of the MODERN PLASTICS Encyclopedia Issue was published in mid-September. This practical workbook contains basic information on virtually every phase of plastics manufacturing and processing—from the selection of raw materials right up to the finishing of the plastics end products. Each article also contains a digest in outline form of the year's developments in that particular field. The Technical Data section has been expanded and revised to take in all new materials introduced within the past year. The comprehensive Plastics Properties Chart (suitable for wall mounting) has also been revised to include new materials and has further been redesigned in the form of a bar chart to simplify its use by the industry. Another innovation in this year's issue is a series of tables in the Engineering and Methods section that provide a concise and handy guide to the molding characteristics of individual materials. As in past issues, the Directory Section has been up-dated to insure readers an authoritative listing of manufacturers, molders, suppliers, etc.

"The Science of Engineering Materials"

Edited by J. E. Goldman

Published in 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. 528 pages. Price: $12.00.

In June 1954, a group of engineering and physics teachers met at Carnegie Institute of Technology ". . . to discuss recent developments in solid-state science and to explore ways and means of including these in engineering curricula." The papers presented there have been collected into this book. Definitely not an elementary book, this work will interest physicists and engineers who want to be up to date on the contributions of solid-state physics to mechanical, electrical, and magnetic properties of engineering materials. The titles of the six main parts and the number of papers in each are: 1) The Structure of Matter (10); 2) Metals and Alloys (6); 3) Surfaces (1); 4) Magnetism and Magnetic Properties (2); 5) Semi-conductors and Dielectrics (2); and 6) Non-crystalline Materials (3). The chapter on high polymers, by Turner Alfrey, Jr., does not contain much that is not in his renowned book on mechanical behavior of high polymers.

"La Stabilisation des Chlorures de Polyvinyle"

By Fernand Chevassus and Roger de Broutelles

Published in 1957 by Les Éditions Amphora, 119 Avenue Parmentier Paris XI, France. 311 pages. Price: 3500 F. (about $8.35).

This useful work, which contains 63 charts and 75 tables, is like the land of its origin, divided into three parts. The first part is concerned with the theory of degradation and stabilization of vinyl chloride polymers, including the effects of heat, light, and oxygen. The second part is devoted to stabilizers in seven chemical classes, and includes a chapter on interaction effects, or synergy, among stabilizers. The third (and largest) part deals with the results of practical studies in stabilization of PVC and copolymers. Throughout the book, several points of view are taken: that of providing protection during hot processing, during high-temperature service, and during exposure to UV and chemicals. There are about 400 references to patents and literature, most of them in English. A 13-page list of commercial stabilizers and their suppliers augments the Table in the MODERN PLASTICS Encyclopedia issue because of its coverage of European sources. There is no general index to the book.

"Beitraege zur Technologie der Hochpolymeren—Gummi und Kunststoffe"

By Wilhelm Späth

Published in 1956 by A. W. Gentner Verlag, Stuttgart, Germany. 300 pages. Price: DM 27.50 (ca. $9.00).

In this phenomenological approach to an understanding of the nature and behavior of plastics and rubber, Dr. Späth applies a method he has previously successfully used in studying metals—gaining an understanding of the material by a study of its creep and flow properties.

The book is divided into three parts. The first deals with the subject of internal and external friction, mechanisms of cohesion, and different types of flow and creep; the second section covers test procedures based on considerations detailed in the first part; and the final section presents applications. Illustrated.

Vinyl chloride resin. Technical data on Brand QYRS vinyl suspension resin recommended to fabricators of extruded products for dry blending operations and for hot processing. 5 pages. *Bakelite Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.*

Variable speed drive. Specifications, engineering data, principles of operation, and available types and controls for Graham variable speed drive changers. 8 pages. *Graham Transmissions, Inc., Menomonee Falls, Wis.*

"The Index of Technical Articles," a new monthly index of articles published in British Technical periodicals, has as its main classifications the following fields (divided into many subclasses): plastics, engineering, architecture,

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management, textiles, paints, foods, and agriculture. Not covered are botany, biology, zoology, and medicine. The April issue contains listings of articles that appeared in the March issues of surveyed periodicals. 101 pages. Subscription price: £6 6s (ca. $17.75). *Iota Services Ltd., 38 Farringdon St., London EC4, England.*

"Welcome to Blaw-Knox" illustrates some of the products engineered and fabricated by the company for industrial applications in food and chemical processing, metallurgy, construction, and utilities. Also listed are the company's principal business locations. 20 pages. *Blaw-Knox Co., Pittsburgh 38, Pa.*

"How to Control the Sun" traces the history of shading devices from their beginnings to the latest innovations in translucent reinforced plastics awnings, and shows how Ray-O-Lite awnings control heat, as compared with unprotected glass and ordinary reinforced plastics panels. Booklet 57-IB. 8 pages. *Ray-O-Lite Corp. of America, 316 Peachtree St., N. E., Atlanta 8, Ga.*

Release agent. Methods of applying Seal-Release by rubbing, brushing, or spraying for easy parting of epoxy resin castings from plaster molds, or from metal, wood, or epoxy masters. Technical bulletin sheet No. 19. *Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N. J.*

Fire prevention. "Combustible Dust Hazards in the Plastics Industry" defines the problem and discusses precautions for prevention of dust explosions, sources of ignition, explosion venting, fire protection etc. 4 pages. *The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.*

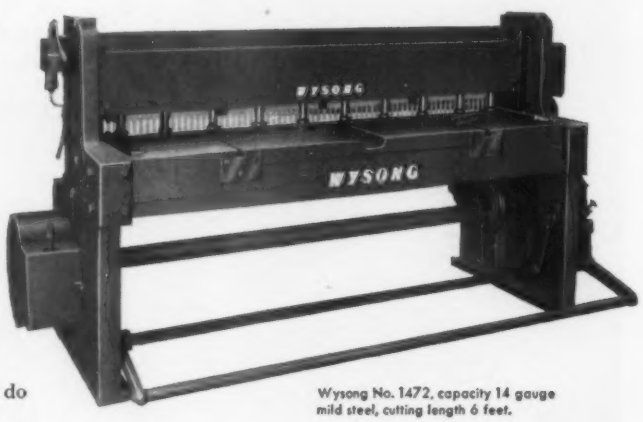
"How to Choose an Extruder," Bulletin E-3, presents the design and performance features of the new Prodex extruders and compares them with those of other machines. Typical package installations are also diagrammed. 50 pages. *Prodex Corp., King George Post Rd., Fords, N. J.*

Boxes. Diagrams and sizes of standard and custom boxes made from the entire range of thermoplastic materials, and how a custom-made appearance can be achieved in a standard box by the use of color and hot stamping. 4 pages. *Plastics Div., Vlchek Tool Co., 3001 E. 87th St., Cleveland 4, Ohio.*

"Plastics Hi-Lites," a new house organ, tells the Hi-Fax story, and how Hercules put America's first plant on stream to produce this polyolefin material using the Ziegler process. 16 pages. *Hercules Powder Co., Wilmington, Del.*

Thermal properties. WADC Technical Report 56-543, "Analysis of the Thermal Properties of Plastic Laminates, Cores, and Sandwich Panels," gives effects of composition on thermal properties, thermal properties (specific

TRY SHEARING



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heat, thermal expansion, and thermal conductivity), and recommendations. Price: 50¢. 12 pages. *Wright Air Development Center, Air Research and Development Command, United States Air Force, Wright-Patterson Air Force Base, Ohio.*

Premix compounding. Group of technical bulletins describing polyester resins, formulations of premixes, color concentrates, and parting agents. 30 pages. *Interchemical Corp., Finishes Div., 1754 Dana Ave., Cincinnati 7, Ohio.*

Printed circuitry. Description of dry screen process of making printed circuits, and how it gives high quality and production volume at low unit cost. Also characteristics of resists, resist removal, and production techniques. 12 pages. *Dry Screen Process, Inc., 1016 Madison Ave., Pittsburgh 12, Pa.*

"Portrait in Plastics," a 25-min., 16-mm. sound and color film, shows how George Eastman's work in photographic film led Eastman Kodak to cellulose acetate as a base for safety film, and from there to a complete line of plastic molding compounds and textile fibers. Beautifully done, as befits a leader in the photographic field, the film also shows how acetate, butyrate, and polyethylene are manufactured. The company's custom color service is also shown. Available on a loan basis from *Plastics Div., Eastman Chemical Products, Inc., Kingsport, Tenn.*

Improved adhesive. Report on an adhesive system developed for the Army, described as having exceptional properties for bonding composite material used in printed circuitry. PB 121960, "Adhesive for Composite Material Used in Printed Circuitry." Price: $2.25. 83 pages. *Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.*

PVC pipe fittings. Technical and installation data on unplasticized PVC pipe, together with complete specifications for threaded and socket types of PVC fittings, valves, and flanges made

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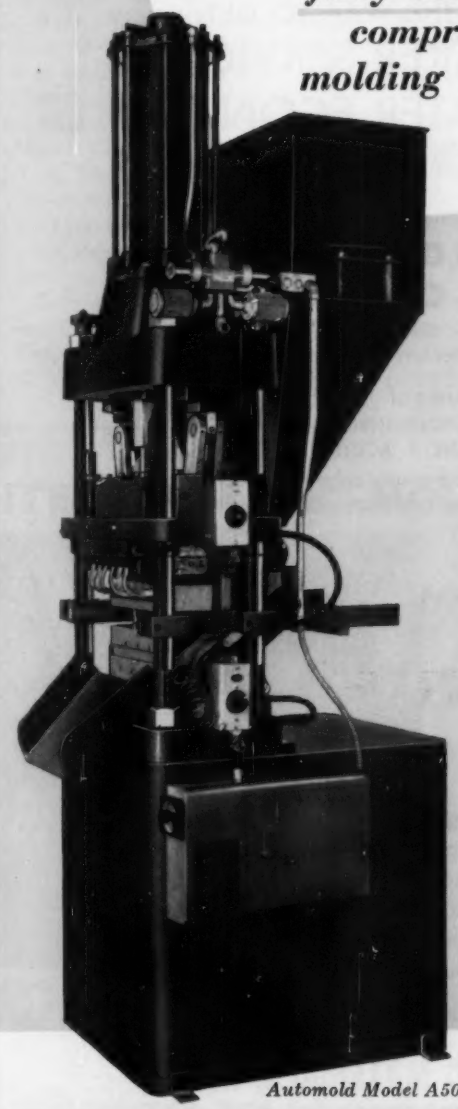

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of both standard and high-impact material. 24 pages. *Tube Turns Plastics, Inc., 2929 Magazine St., Louisville 11, Ky.*

Luminescent pigments. "Lights Out! Violite . . . On" describes numerous applications for Violite luminescent pigments in plastics for use in home and industry. 20 pages. *Rhode Island Laboratories, Inc., 100 Pulaski St., W. Warwick, R. I.*

Molding services. Listing of company's automatic injection molding machines, its technical consultation service, mold design and construction service, and special maintenance service. 6 pages. *Molding Systems, Inc., Danielson, Conn.*

"Tech-Talk," a new technical newsletter, describes the Schlumberger nuclear magnetic resonance analyzer, Model 104, an analytical instrument used for the quantitative measurement of hydrogenous liquids (water and oils) in solid materials. 6 pages. *Schlumberger Well Surveying Corp., Ridgefield, Conn.*

"Investigation of the Vacuum-Forming Process for Plastics Fabrication (U)," PB 121954, describes techniques recommended to Chemical Corps laboratories for improved and more economical forming of plastics materials. Price: 50¢. 14 pages. *Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.*

Color concentrates. Price and application data for Ferro standard liquid epoxy paste color concentrates; also a list of epoxy resin suppliers. Code 6-30-57. 4 pages. *Ferro Corp., Color Div., 4150 E. 56th St., Cleveland 5, Ohio.*

Epoxy dermatitis. Thirty-six specific and practical rules for the prevention of epoxy dermatitis. 12 pages. *Milburn Co., 3246 E. Woodbridge, Detroit 7, Mich.*

Injection molded containers. Illustrations and color and size data for more than 150 square, compartmented, round, and spe-

cialty and novelty injection molded plastics containers are given. 8 pages. *Harkin Affiliates, Inc., 95 Madison Ave., New York 16, N. Y.*

Liquid polymer. Data on properties, processing, and compounding of LP-31, high-molecular-weight liquid polysulfide polymer, which can be used successfully in sealing applications in aircraft, ships, buildings, and machine components. 8 pages. *Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.*

Small electronic instruments. Line of small-size self-balancing electronic potentiometers and bridges available in three basic circuit types: a.-c. bridge; d.-c. potentiometer; and differential transformer balance. Bulletin P1271. 4 pages. *The Bristol Co., Waterbury 20, Conn.*

"The Modern Touch," a 15-min., 16-mm. sound and color film, shows how vinyl copolymer-based paints, when formulated specifically for interior or exterior applications, can be easily applied to provide durable and colorful protection for both industrial and home use. Available to paint manufacturers. *National Starch Products, Inc., Resin Div., New York, N. Y.*

Encyclopedia corrections

The following omissions and corrections are noted for the 1957 MODERN PLASTICS Encyclopedia Issue. It is suggested that they be transferred to readers' copies for future reference.

Amos Molded Plastics, Edinburg, Ind., extruders and injection molders, was omitted from *Custom Molders,* on page 1078.

Atlas Coatings Corp., Long Island City, N.Y., was omitted from *Emulsions and Dispersions* under the classifications (A, C, D, Q) on page 1029, and from *Inks (For Printing Plastics)* on page 1057.

Correct listings in the *Materials and Chemicals* section for **Catalin Corp. of America,** New York, N. Y. are: *Adhesives,* (O, Q, T), page 1024; *Emulsions and Dispersions,* (K), page 1029; *Molding Compounds, Manufacturers of,* (M, O, R, S), page 1034; *Resins,* (Q, T, U, Y, BB, CC, NN) page 1036.

Correct address for **Claremont Pigment Dispersion Corp.** is 39 Powerhouse Rd., Roslyn Heights, N.Y. This company was omitted from *Inks (For Printing Plastics)* on page 1057.

A. W. Peterson & Sons Die Co., New York, N.Y., was omitted from *Die Makers, High Frequency Heat Sealing* on page 1064.

Plas Tube, Inc., is located in Springdale, Conn. (Page 1140).

Plymouth Fibers, Inc. is located at 195 Plymouth St., Brooklyn, N.Y. (Page 1141).

Paraplex, the trade designation for Rohm and Haas Co. polyester resin, and **Plexiglas,** the trade designation for Rohm and Hass Co. acrylic resin, molding powders and cast sheets were omitted from the *Trade Name Directory* on pages 1117 and 1118, respectively.

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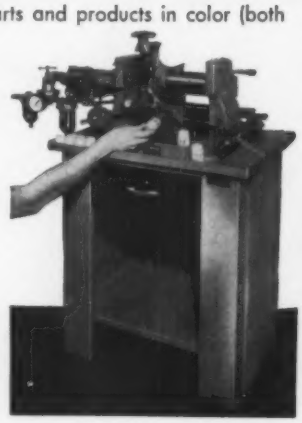

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mp Plastics

Production and sales in 1000 lb.* for June and July 1957

Materials	Total p'd'n first 7 mos. of 1957‡	Total sales first 7 mos. of 1957‡
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	11,222	10,613
Sheets, 0.003 gage and over	10,141	9,936
All other sheets, rods, tubes	4,117	4,060
Molding, extrusion materials	51,187	50,703
Nitrocellulose sheets, rods, tubes	2,457	2,499
Other cellulose plastics	3,203	2,712
Phenolic and other tar-acid resins:		
Molding materials[a]	104,989	100,972
Bonding and adhesive resins for:		
Laminating (except plywood)	34,810	26,848
Coated and bonded abrasives	9,898	9,479
Thermal insulation	29,985	29,406
Plywood	27,046	20,501
All other bonding uses	31,805	29,748
Protective-coating resins	17,424	14,563
Resins for all other uses	21,664	18,855
Urea and melamine resins:		
Textile-treating resins	20,732	20,126
Paper-treating resins	15,379	13,998
Bonding and adhesive resins for:		
Plywood	53,833	52,566
All other bonding and adhesive uses, including laminating	17,114	16,144
Protective-coating resins	21,218	15,994
Resins for all other uses, including molding	51,493	51,949
Styrene resins:		
Molding materials[a]	235,487	230,530
Protective-coating resins	47,908	46,589
Resins for all other uses	84,661	69,718
Vinyl resins, total[b]	473,161	433,417
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		53,494
Sheeting (resin content)		31,958
Molding and extrusion (resin content)		126,433
Textile and paper treating and coating (resin content)[c]		36,146
Flooring (resin content)		46,762
Protective coatings (resin content)		20,396
All other uses (resin content)		26,159
All other vinyl resins for:		
Adhesives (resin content)		24,787
All other uses (resin content)		67,296
Coumarone-indene and petroleum Polymer resin:	144,792	145,610
Polyester resins:	55,943	50,318
Polyethylene resins:	378,175	363,701
Miscellaneous:		
Molding materials[a, d]	27,554	27,011
Protective-coating resins[e]	7,591	3,755
Resins for all other uses[f]	75,864	69,239

*Dry basis designated unless otherwise specified. †Revised.
‡Partially estimated. ¶Includes friction materials.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

June†		July‡	
Production	*Sales*	*Production*	*Sales*
1,796	1,756	1,390	1,351
1,570	1,578	1,009	1,257
729	599	472	513
7,794	7,433	6,621	6,388
270	295	233	299
468	422	341	262
†13,656	†13,164	12,025	11,858
4,986	3,623	4,099	3,500
†992	†1,027	965	1,117
4,645	4,263	4,699	4,874
†3,881	†2,838	3,579	2,870
†4,400	†4,132	4,985	4,445
2,431	1,992	1,514	1,465
3,001	2,581	2,255	1,958
2,338	2,373	1,864	2,030
†2,260	†2,081	1,901	1,870
†7,287	†7,752	6,715	6,866
†3,089	†2,382	2,556	2,467
2,911	2,375	2,527	1,785
7,293	6,522	5,020	6,508
31,394	24,178	29,007	32,361
5,550	5,201	6,024	7,065
†11,915	†8,448	9,882	8,653
†68,327	†60,177	63,272	53,285
	†7,123		6,342
	†4,043		4,362
	†16,962		14,340
	†4,744		5,372
	†6,265		6,030
	2,362		2,755
	†3,829		2,872
	†4,685		3,236
	†10,164		7,976
17,083	18,072	21,603	20,713
8,178	7,199	7,209	6,826
56,074	51,037	55,357	50,582
3,491	3,425	3,834	3,518
1,008	499	1,032	565
†11,408	†9,650	10,594	9,516

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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Curb static electricity problems in plastic production by using light applications of Statikil on plastic materials and machinery. This original, registered, anti-static spray eliminates all troubles in manufacturing operations when it contacts static attracting surfaces and areas by immediately dissipating any existing charge. Continued use is accumulative, reducing the frequency of future static evidence.

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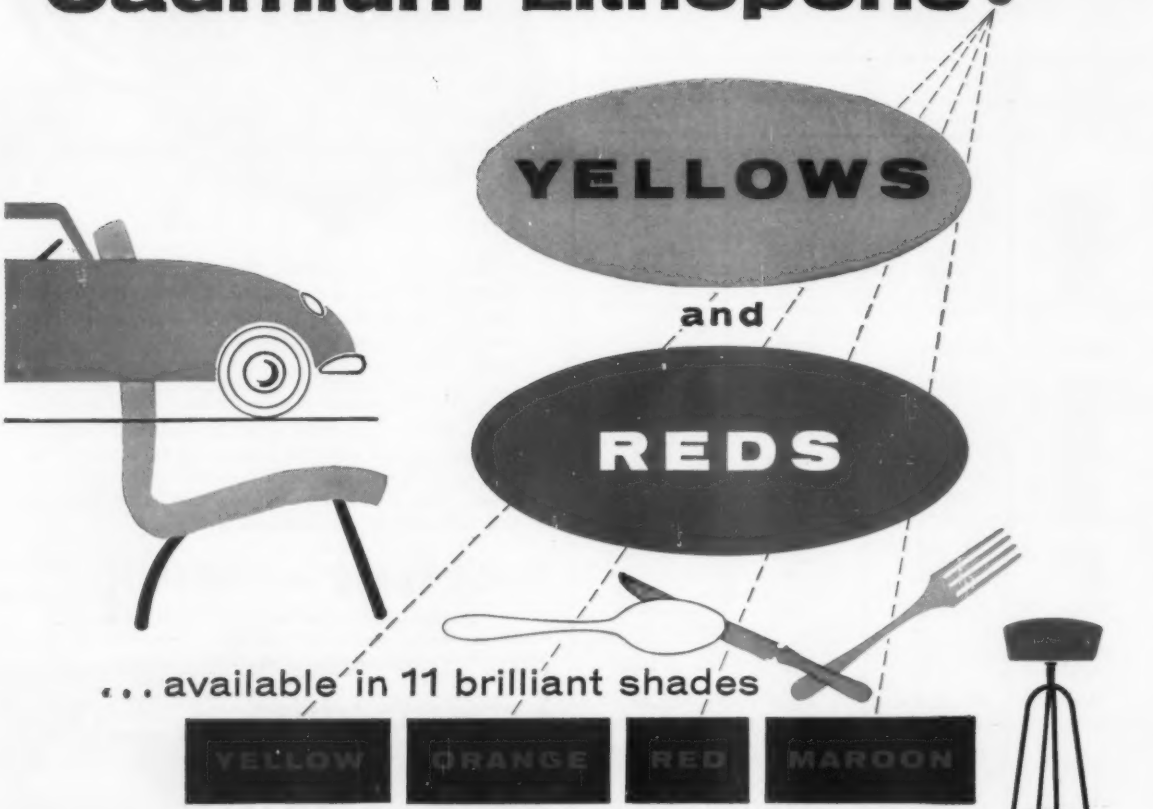

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The Platform

Where readers may voice their opinions on any phase of or problem in the plastics industries, controversial or otherwise. The editors of MODERN PLASTICS take no responsibility for opinions expressed in letters herein.

The Editor, MODERN PLASTICS:

As an individual involved in a business which is in a sense a bridge between the plastics and building industries, I am keenly aware of the natural intensification of interest developing between them.

Statistics clearly indicate the importance of this market for plastics today, and reveal for tomorrow a potential of vast proportions.

I believe that materials technology has progressed far beyond the ordinary abilities of the building industry. It is much like an architect attempting a thin-shelled concrete structure with little tangible training and experience in concrete. The plastics industry has created ample interest in its materials. It is now most appropriate for it to direct its attention to a comprehensive educational program. A major bottleneck is now the lack of educational opportunity for the building industry regarding plastic materials.

I am aware of the large publicity and educational program which the plastics industry has conducted over the years. However, most of this has been directed to the general public and industry in general. The building industry represents so large a potential that it requires specific materials and services.

I find only a small number of Schools of Architecture prepared to offer materials courses in plastics. I am aware of no reference materials or books prepared for architects. I do not believe it is possible for very many architects to participate in the national meetings of an educational nature of professional groups such as B.R.I., S.P.I., S.P.E., and A.I.A. Many architects in the country do not know of any professional source of information and assistance regarding plastics as building materials.

I appeal to the plastics industry to conceive of a grass roots educational program specifically oriented to the building family. Such a program should provide 1) a means of providing an immediate extensive training to several staff members in each of the Schools of Architecture; 2) statewide seminars and correspondence courses to reach the busy practicing architect; 3) an extension of secondary programs designed to reach the application and distribution crafts of the building industry; 4) the specific development of course and reference material for all levels; 5) a study to determine whether architectural and engineering specialization will be necessary as in such fields as illumination, acoustics, heating, etc.

In summary, let us not overlook a primary task. The building industry understands the differences betwen oak, pine, and fir; it understands metals and concrete. Yet it generally does not know the names of the basic plastics families and little of the range of their physical properties. I believe that the building industry will welcome a better opportunity to learn. It will provide its own motivation and must be considered a "joint venturer" rather than a recipient. It has clearly demonstrated its courage in the creative applications of plastics already made. Plastics are remarkable design materials; I forsee a great and rewarding union of architecture and plastics.

George R. Hermach, *president Architectural Plastics Corp., Eugene, Ore.*

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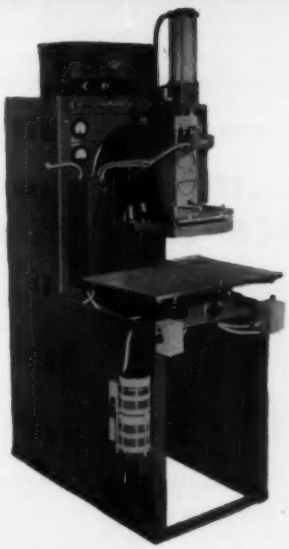

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...that HE's wearing

THICK—The sturdy helmet and transparent face guard withstand bone-crushing blows. Vlchek made them to last!

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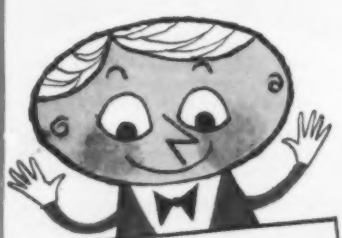

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Thirty-four acres of vinyl material that will not feed or spread a fire protect big new automotive stamping plant built by Chrysler Corp. at Twinsburg, Ohio.

Vinyl in fire-retardant roof

In a giant new automotive stamping plant put up by Chrysler Corp. at Twinsburg, Ohio, vinyl film was used instead of conventional asphaltic materials throughout the roofing.

Purpose of the replacement was to provide a roof that would not feed or spread a fire. Tests by Factory Mutual Laboratories, Norwood, Mass., have proved that asphaltic materials used between a metal roof deck and insulation give off combustible gases in the heat of a fire, according to the construction company. These gases are forced down under pressure through the roof, where they ignite and spread fire.

The new fire-retardent roofing consists of vinyl film and a nonflammable adhesive, installed between a steel roof deck and board roof insulation. The top surface of the roof is protected by the usual tar and gravel.

The installation, which covers a full 34 acres or 1.4 million sq. ft., was engineered by Lexsuco Inc., Cleveland, Ohio, which also distributes the materials involved.

Besides retarding fire, the vinyl film will eliminate the dense black smoke that usually accompanies a building fire and makes fire-fighting difficult. In addition, the vinyl acts as a vapor barrier and protects the insulated built-up roof from the damage of moisture immigration, often undiscovered until the damage is beyond repair.

Installation of the huge fire-retardant roof was recently completed at the Twinsburg Chrysler plant. The job was completed by a 60-man crew in less than six months.

With the Lexsuco roofing system it is possible for a contractor to provide, economically, a completely protected built-up roof, according to a spokesman for the company.

The roofing system has been awarded a Class 1 rating by Factory Mutual Laboratories.

Credits: Koroseal vinyl vapor barrier manufactured by B. F. Goodrich Industrial Products Co., Akron, Ohio.

Rolls of vinyl film, a few of the thousands used in application, are lined up ready to be unrolled. (Photos, B. F. Goodrich)

Ice tray package

A reusable molded polyethylene package that doubles as a refrigerator tray for making ice "cubes" shaped and marked exactly like golf balls (complete with dimples and trademark) has been adopted by United States Rubber Co. as a Christmas-time promotion gimmick for stimulating sales of its golf balls. Each half of the two-piece package (photo, above) contains contoured recesses in which the golf balls sit; the same recesses are used for freezing the novelty ice balls. The halves thus made can be simply pressed together to form a complete ball (photo, below). Other reuse possibilities for the package—salad mold, dessert mold, or egg tray.

Credits: Molded by Pyro Plastics Corp., Pyro Park, Union, N. J., of Bakelite polyethylene.

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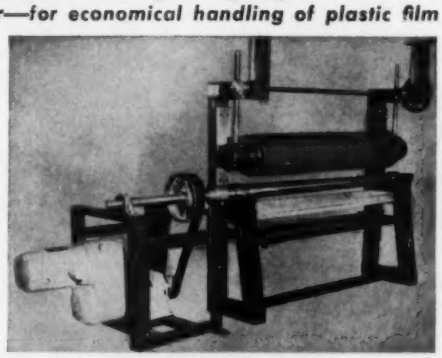

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Du Pont Pigments add beauty... practicality... versatility

NATURE'S COLORS ARE RIVALED BY DU PONT PIGMENTS

The macaw's myriad colors captured with easily dispersed, lightfast Du Pont Pigments for your plastics

You can capture Nature's most brilliant colors for your plastics – create others even the macaw would envy–with Du Pont Pigments. In addition to a wide range of colors, these pigments give you many important sales advantages–properties that help your plastics stay brighter longer.

LIGHTFASTNESS – For example, "Monastral"® and "Ramapo" Blues and Greens and Green-Gold are the most lightfast of all organic pigments–an especially important feature with your pastel-colored plastics.

BALANCED PROPERTIES–Resistance to bleed, migration and crocking are desirable properties in many plastics systems. In addition to the "Monastral"® Greens and Blues, the Chrome Yellows, Molybdate Oranges, "Watchung" Reds and Green-Gold are also highly resistant to bleed, migration and crocking, and are easily dispersed.

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Durable Organic Yellow
Monastral® Blues and Greens
"Ramapo" Blues and Greens
Molybdate Oranges
Chrome Yellows
Shading Yellow
"Watchung" Reds
Pyrazolone Reds

A variety of bright, intense colors, available from the Du Pont quality line of pigment colors, are displayed by Chrome Yellow, "Monastral"® Blue and Green and "Watchung" Red used in heat-sealable polyvinyl foam.

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Radar plotting board, the world's largest, in operation at Air Defense Command, Colorado Springs, Colo. The main board (left) uses eight of the largest cast acrylic sheets manufactured in its construction. Radar operators work at ascending tiers of desks for unobstructed view of board. (Photo, Cadillac Plastic)

Giant plotting board

A massive piece of cast acrylic, 30 ft. long by 19 ft. high and ½ in. thick, has been fabricated as a radar plotting board for the Air Defense Command, Colorado Springs, Colo.

Purpose of the device, which is the world's largest radar plotting board, is to plot movements of unidentified aircraft anywhere in the U.S., Canada, or possessions. The huge board was constructed on the job site from eight 100- by 120-in. sheets, the largest sheets of methyl methacrylate manufactured to date.

Acrylic was chosen for the application because of its combination of light weight, unbreakability, and the ease with which it can be marked. Grease pencil marks on the board are used to fix the location of aircraft. These areas pick up light from the illumination which enters through the edges of the acrylic and provide for high visibility—an essential requirement for this plotting and tracing operation.

The size of the board made weight an important factor; the eight cast acrylic sheets alone weigh more than a ton. With the extruded magnesium channels which form the framework of the installation, the complete plotting has a weight of approximately 3750 pounds.

In the fabrication of the board, the sheets were prepared with butt joints, and bonded with quick-setting bodied-solvent cement. The bonds have excellent optical properties and are invisible under normal light. Under the strong edge lighting of the radar installation, the bonds show up as faint white streaks. The edge lighting is provided by fluorescent tubes mounted directly to all four edges of the board. The magnesium channels which form the framework of the panel also serve to conceal the edge lighting from direct view.

The principal plotting board is flanked by four auxiliary wing boards, ranging in size up to 19 by 15 feet.

Credits: Plexiglas cast acrylic sheet manufactured by Rohm & Haas Co., Philadelphia, Pa., and supplied by Cadillac Plastic & Chemical Co., Detroit, Mich.

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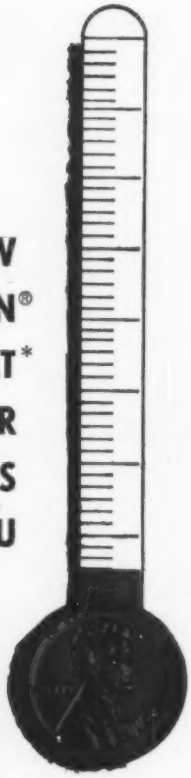

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*Low temperature

Comparison of Plastolein 9078 with di-decyl adipate

Plastolein 9078		DDA	Plastolein 9078		DDA
Parts Geon 101	100	100			Borderline
Parts Plasticizer	48	49	Masland Impact, ° C	—40	at —40
Tensile, psi	2650	2400	Extraction, mg/in²		
Elongation, %	365	360	Water, 24 hrs. @ 50° C	0.2	0.1
Modulus, 100%, psi	1130	1240	Soapy Water, 24 hrs.		
Hardness, D.10 sec.	85	89	@ 50° C	1.0	0.4
Volatility, SPI, 70° C			Min. Oil, 24 hrs. @		
1 day-mg/in²	1.9	2.3	25° C	11.1	19.8
7 days-mg/in²	8.0	9.1	Compatability, Roll Spew	Slight	Severe

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- ☐ Please send a pint evaluation sample
- ☐ Please send a technical representative

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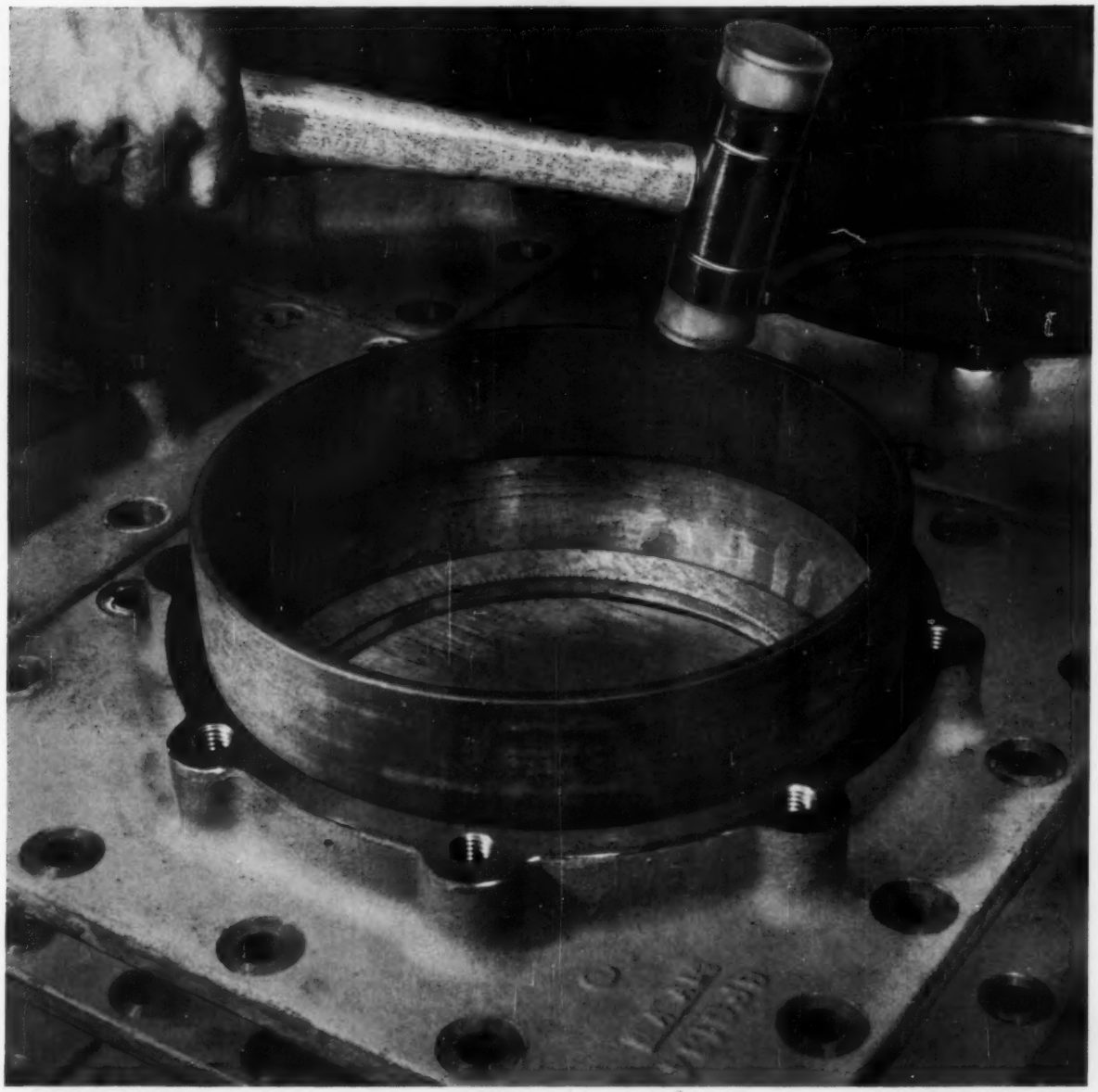
Pickle forks

Their use to the contrary, molded styrene pickle forks appear to be one of those plastics applications that doesn't have to worry too much about business turning "sour." Already accepted as a standard accessory at the dinner table, the pickle fork has remained over the years as a steady, continuing market for plastics.

H. J. Heinz Co., for example, which uses styrene pickle forks as a free premium to be distributed with the various pickle varieties in its line, reports that since 1947 alone more than 10 million pickle forks of varying sizes and designs have been given away. As with any other larger or more dramatic product that uses plastics, the design potential of the material has been put to work by Heinz in making each new pickle fork more functional and modern than the previous year's version. This year's model, for example, is molded of pure white styrene with the company's tradename and trademark hot stamped in gold, red, green, and blue on the face of the fork to add a touch of elegance. The new forks are also longer for more convenient handling. They are injection molded in a 4-oz. press at the rate of 5000 per hour.

Credits: Forks are molded for Heinz by Spir-it Corp. Malden, Mass., on a 4-oz. Lester machine. Hot stamping presses by Peerless Roll Leaf Co., Inc.

Molded styrene pickle forks are offered as free premium by pickle supplier



CAT* CRADLE – The extremely rugged field conditions to which heavy construction equipment is constantly subjected has made the engineers of Caterpillar Tractor Co. experts at solving complex material and metallurgic problems. In the construction of the tandem drive housing used in Caterpillar's No. 112 Motor Grader, for example, special bushings were required that could operate, not only with a minimum of lubrication, but would withstand the constant rocking and heavy shaft loads as well. For this purpose, Caterpillar* adopted special laminated phenolic plastic bushings which are graphite impregnated and able to stand up under these extremely severe oscillating conditions. These bushings were manufactured by The Richardson Company of Melrose Park, Illinois, using Mount Vernon Duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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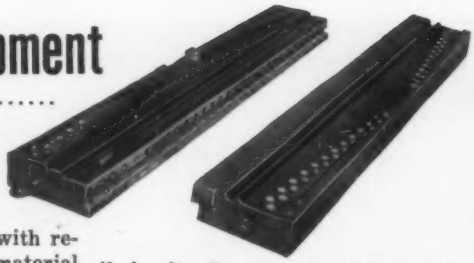

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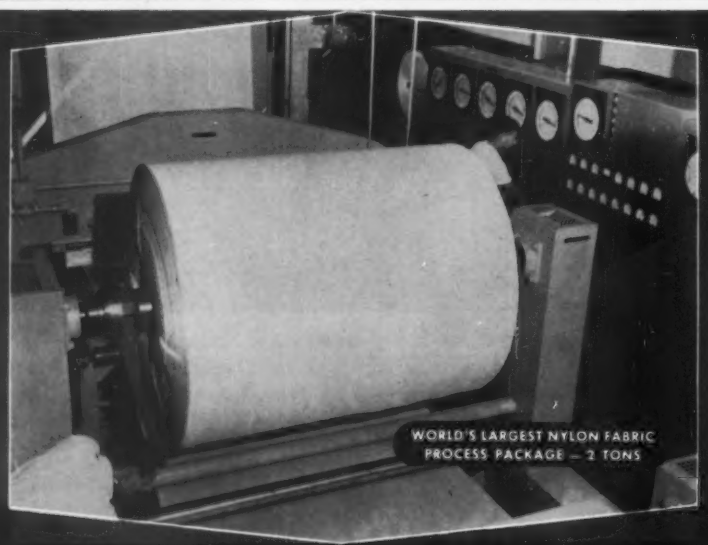

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Aluminum-epoxy cement

Aluminum-filled epoxy resin compounds, having made their mark as an industrial caulking and cementing material, are now being marketed in self-metering tubes that provide additional conveniences and economies.

The material is supplied in two tubes—one containing the aluminum-filled resin and the other a low-toxicity catalyst. The proper proportion is obtained by squeezing out identical lengths of material from each tube. The two different colored components are then mixed to a uniform color.

Following addition of the catalyst, the material will harden at room temperature. For quick repairs, slight heat may be applied. The finished repairs can be machined by conventional methods to a feather edge.

The aluminum-epoxy material is used as a smoothing and caulking compound; as a patching material for metals, wood, plastics, and concrete; or as a repair cement for leaking tanks, pipes, conduit, and windows. It can also be used as an adhesive for bonding metals, wood, concrete, and glass. It is completely water- and oilproof, resists acids and alkalies, and is non-flammable. It can be applied to vertical surfaces without sagging even after extended storage.

Credits: Metalset A4 compound supplied by Smooth-on Mfg. Co., Jersey City, N. J.

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Recently completed tests of PARAFLINT blended with polyethylene demonstrate the versatility of this new low cost synthetic wax. Formulations containing up to 15% PARAFLINT indicate that improvement in tensile yield strength, stiffness, gloss and permeability can be obtained. PARAFLINT raises the melt index of Polyethylene, enabling faster molding cycles without flow stresses, and permits lower molding temperatures, thus reducing thermal breakdown.

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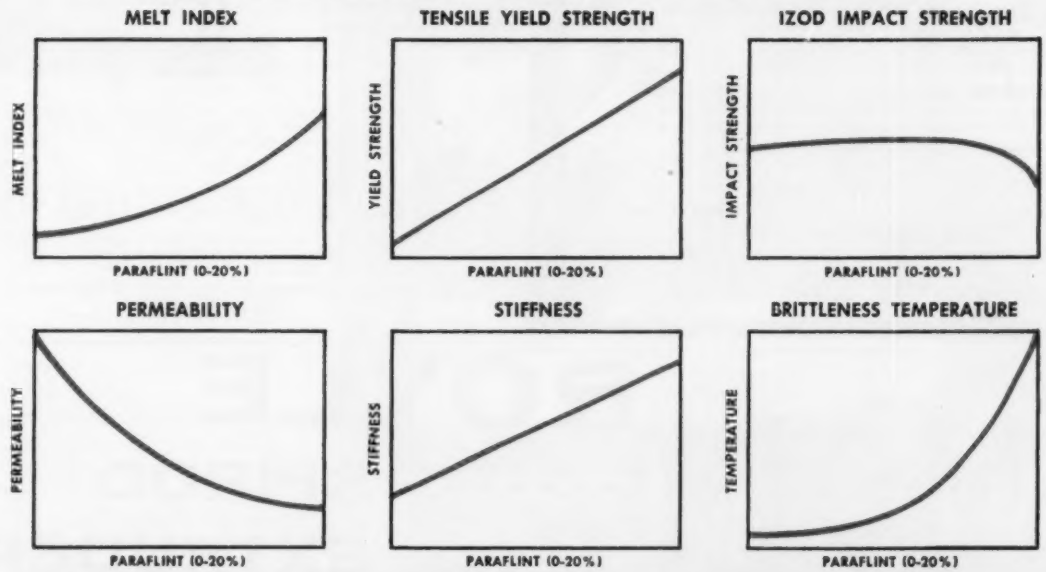

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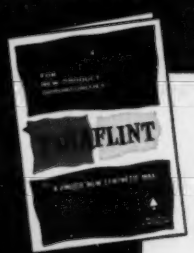

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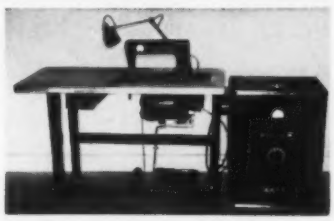

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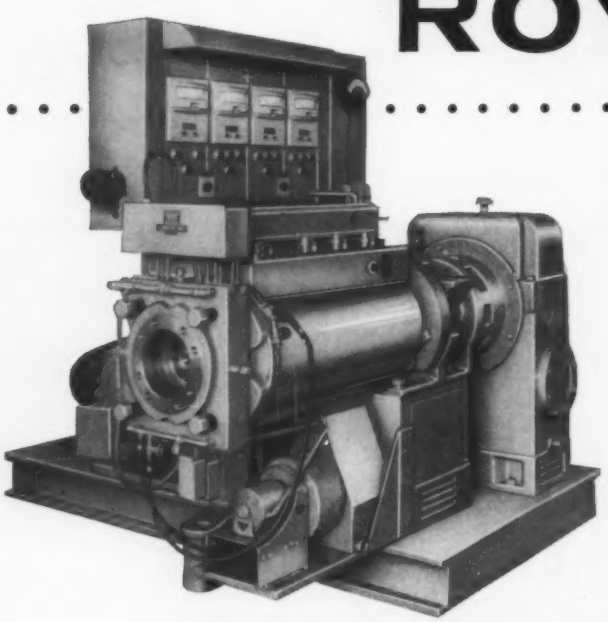
ROYLE SPIROD EXTRUDERS



These all electric extruders with radiant heat and high velocity evaporative cooling are designed to process either plastic or rubber compounds. The result of more than three quarters of a century of experience — Royle pioneered the extrusion process in 1880— in the design and construction of extruding machines time tested features have been built into Spirod to assure dependability.

Write for Bulletin #463

JOHN ROYLE & SONS ROYLE PATERSON N. J. 1880

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Moisture eliminator

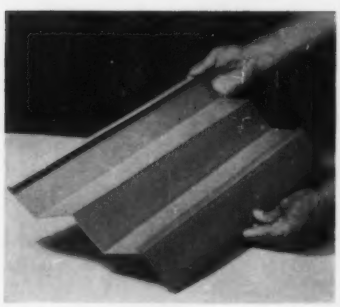
A simple flow-through chamber, made entirely of rigid vinyl, is being employed to remove moisture and suspended contaminants from the air of large industrial plants.

The moisture eliminator chamber is the central unit of an integrated air conditioning system. Its interior consists of many channels formed by deeply corrugated vertical walls of a vinyl extrusion. As the air passes through the channels, the corrugations baffle the flow and allow moisture to condense on the smooth-surfaced walls.

The sections have effectively replaced similar designs made of metal. Even when coated with protective materials, the metal parts had to be replaced frequently as the result of severe corrosion. The rigid vinyl components have proved that continuous exposure to moisture and chemical fumes does not damage either their physical properties or appearance.

The chamber is light in weight and only simple supporting structures are required. Maintenance and cleaning are virtually eliminated. The smooth-surfaced extrusions inhibit the buildup of deposits that might eventually interfere with the proper flow of air. Plant safety is also improved, since the vinyl used will not support combustion.

Credits: Baffle sections extruded by Southern Plastics Co., Columbia, S. C., from high impact Geon vinyl supplied by B. F. Goodrich Chemical Co., Cleveland, Ohio.



Rigid vinyl baffle designed to remove moisture, suspended contaminants from air in industrial plants. (Photo, B. F. Goodrich)

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In the plant of a midwest custom molder, a Robertson Resin Engineer (right) inspects the final result of his technical assistance and the successful use of Robertson Stypol resin reinforced with glass fiber.

Robertson Stypols (polyesters) have an unusual ability to bury glass fibers so that the surface of molded parts is very smooth to the touch and attractive to the eye. In addition, these resins offer outstanding craze and blow resistance on short high temperature cure cycles, plus far better than average hot strength and mold release properties particularly in complex large moldings. Clip the coupon below and attach it to your letterhead if you would like a qualified Robertson engineer to work in your shop with you on your specific problem.

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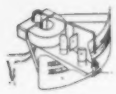

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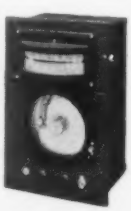

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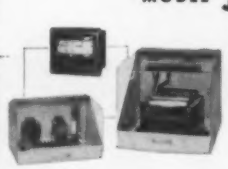

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of MODERN PLASTICS, published monthly at Bristol, Connecticut, for November 1, 1957.

State of New York

ss.

County of New York

Before me, Notary Public in and for the State and County aforesaid, personally appeared Alan S. Cole, who, having been duly sworn according to law, deposes and says that he is the Publisher of MODERN PLASTICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), to wit:

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Alan S. Cole, 575 Madison Ave., New York City.

Editor, Hiram McCann, 575 Madison Ave., New York City.

Managing editor, A. Paul Peck, 575 Madison Ave., New York City.

Business manager, M. A. Olsen, 575 Madison Ave., New York City.

2. The owner is: (if owned by a corporation, its name and address must be stated and also, immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as those of each individual member, must be given.)

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3. The known bondholders, mortgagees, and other security holders owning or holding one percent or more total amount of bonds, mortgages, or other securities are: None.

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ALAN S. COLE, Publisher

Sworn to and subscribed before me this 25th day of September, 1957.

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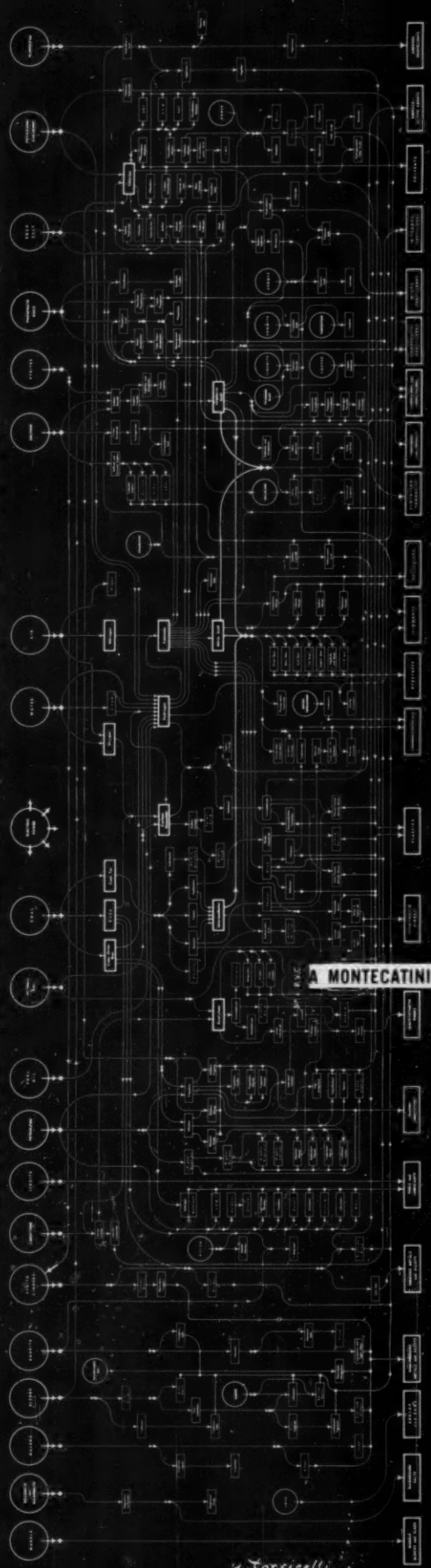
No. 31-6689250. Qualified in New York County.
Commission expires March 30, 1958.



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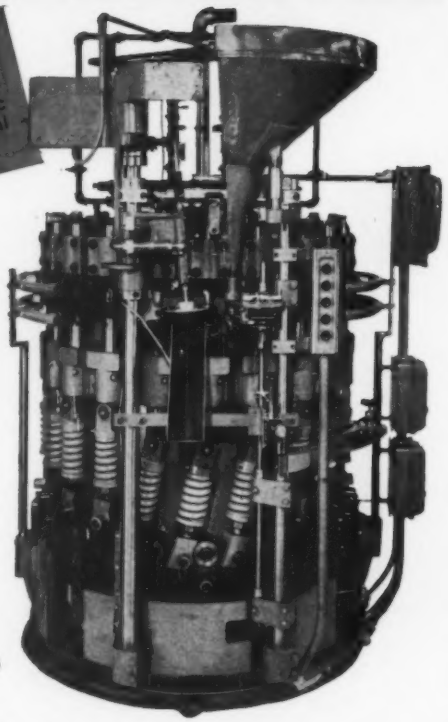

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WARREN, PA.

The economics

(*From pp.* 99-101)

broom-pushers." The better the setup man, the better trained the operator, the more money the machine will make.

Recent developments

Aside from the normal extruder operations such as pipe, rod, and profile extrusion, blown film manufacture, sheet making, compounding wire and cable coating, and blow molding, the above-mentioned developments have been translated into some remarkable new activities.

The following examples sound fictional but are simple fact.

Three or more sizes of pipe are extruded from a single die. In this case, separate take-off speeds had to be arranged for, but the economy of the process is quite obvious. With proper die design there is no reason why up to a dozen pipelines cannot be made at the same time.

Wallboard out of styrene alloy, surfaced by post-extrusion lamination, is being made in quantity today. Here the trick was die design and the development of a take-off that would prevent warpage.

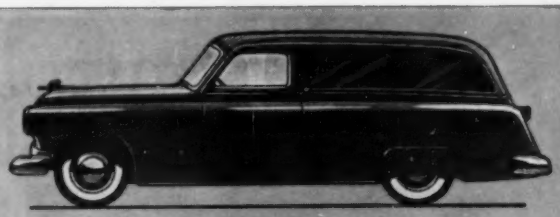
The same combination of elements is currently successfully producing curved longitudinal-section extrusions.

Two, three, or four extruders operating together through a single die are used to produce film 40 ft. wide or more for the construction and agricultural fields. Similar setups are producing various extruded shapes in two or more colors.

At the recent British Plastics Exposition there was shown an extruder filling 10 indexed molds revolving on a turntable. Thick-walled pieces were thus produced at the rate of 2 per minute. Since the full molding cycle is a relaxed 4½ min. turn, it could be one answer to the elimination of molded-in stresses. The machine was described in MODERN PLASTICS 35, 164 (July 1957).

These and other application and process developments will be thoroughly discussed in later articles which will appear in this series.—END

From colorful and durable panels for delivery trucks to handsome television cabinets...



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Life floats
Ballistic panels
Helmets
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Trays
Tote boxes
Food lockers
Garbage pails
Baskets for automatic dishwashers
Baskets for automatic washers
Wash tubs
Tool chests
Shipping containers
Instrument cases
Laundry hampers
Kitchen containers
Fishing rods
Sinks
Street signs
Traffic signs
Fluorescent light fixtures
Television cabinets
Loudspeaker housings
Gas meter housings
Structural panels for offices and homes
Door and transom lights
Awnings and canopies
Greenhouse panels
Skylighting
Molded chairs
Prefabricated houses and garages
Truck bodies

COUNTLESS products benefit from the combination of beauty and durability Pittsburgh SELECTRON Polyester Resins can give—and usually at reduced manufacturing costs.

SELECTRON Resins are used in products ranging from truck panels that withstand extreme hot and cold, rain, snow, and sleet to television cabinets that serve as focal points of beauty in homes everywhere.

SELECTRON Resins are thermo-setting polyesters which are available in consistency from a thin syrup to extremely high viscosity. They polymerize to form solids, with or without heat and with or without pressure.

When combined with such fillers as fiber glass, cotton, rayon, nylon, felt, sisal, paper, etc., SELECTRON Resins provide a new kind of material that is lighter than aluminum, yet—weight for weight—is stronger than steel. This material has great impact resistance and withstands the deterioration influence of weather, sunlight, heat, abrasion and many chemicals. It can be molded in durable colors.

Parts in which SELECTRON Resins are used can be molded either by hand lay-up, direct molding, continuous lamination or pre-forming. These resins can also be used without fillers for casting, potting and impregnating.

Investigate the advantages of SELECTRON Resins that may make your products better looking, stronger and more durable. We'll be glad to have one of our engineers discuss your problems with you without cost or obligation. Such a visit may point the way to important production economies and added sales appeal.

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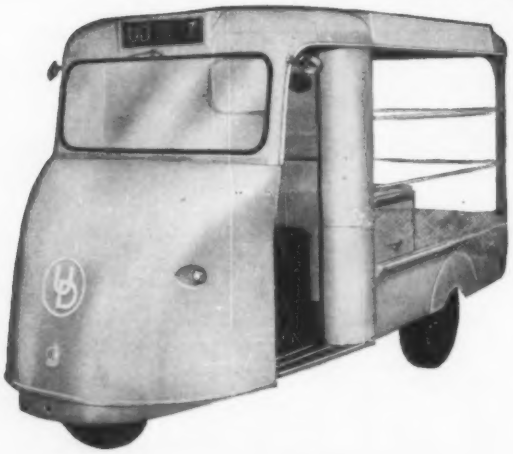
in this all-plastic u.d. milk float



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Credit cards

(*From* p. 105)

entire credit transaction to be completed at the motorist's elbow —reducing delays to a minimum —and gives protection to blank and completed invoice forms.

Variations in the design and type of information embossed on the plastic credit cards reflect the many kinds of businesses served. For example, cards used by hospitals and clinics may carry the patient's blood type, the notation that he is diabetic, or other data which could prove invaluable in the event of an emergency. Some cards are supplied with an adhesive back on which hospital records may be kept.

An entirely new system of library book-charging, called Bookamatic, incorporates the use of plastic credit cards as borrowers' identification cards. These, together with permanent plastic bookcards on which the book information is embossed, and a library imprinter provide the means of accurately identifying the book to the borrower on a three-part transaction form. As a by-product of each charging operation, a prewritten over-due notice and a circulation record are obtained.

Plastic library cards also serve as functional student identification cards throughout a college or university campus, in such areas as registration, student activities, book store, cafeteria, athletic equipment use, and dispensary, as well as in the library.

The Addressograph company's self-writing plastic card is also employed to meet the increasing demands of industry for mechanically written production information. Shop operations, written by hand, too often produce illegible hard-to-read figures that must be entered into accounting machines and systems. A plastic identification card with photo, fingerprint, and signature, embossed with name, check number, department number, and other information provides a one-piece answer to all these problems.

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Model CS-90

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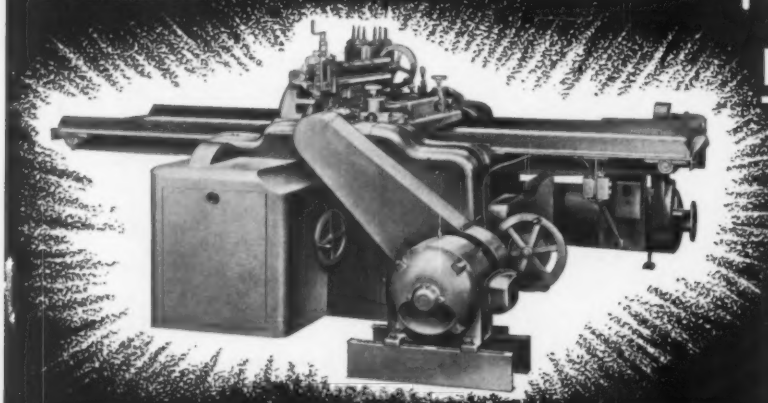

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Plastics tote boxes

(*From pp.* 106-111)

open." Regal Plastic does not have a proprietary line, but does a big custom business in contour-formed boxes and trays with precision-parts producers and the government.

Every variation of thermoforming, involving either vacuum, air pressure, or mechanical assists (or combinations thereof), is used in production of thermoplastic tote boxes from flat sheet. One of the box-forming techniques most popular with Durable Formed Products, Inc., New York, N.Y., specialist in pressure forming, is the so-called "undercut" method, wherein the plastic sheet is forced into a female mold with air pressure and ring. This system gives a smooth, finished edge to the box since the raw edge is turned during the forming.

This company has also done considerable development work with the slip-ring forming method. Here a pusher plug is used to encourage the material to slip under the clamp and draw into the side walls, thereby producing thicker wall sections in the finished part. After the flat sheet is formed into a tote box, the flash is trimmed either by hand or by die cutting with a clicker. Then the raw edges are smoothed on a buffing wheel.

In the manufacture of reinforced plastics boxes, more automatic production methods are employed. They require considerably higher capital investment. Polyester resins, reinforced with textile-grade glass fibers, are formed in matched steel molds under 125 to 175 p.s.i. and steam heated from 1 to 15 min. at 225 to 250° F., depending upon the application, type of resin, and thickness of the part being made. Edges and surfaces are generally finished smooth in the press.

Who uses them?

Among the big customers for both types of plastics tote boxes today are the electronic, electrical, and aircraft industries. These fields seem to offer the greatest potential for the future as well, since they deal in large quantities of complex precision parts. How-

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ever, totally unrelated fields such as food and chemical processing are becoming good customers. Molded Fiber Glass Tray Co. introduced reinforced plastics tote boxes to the baking industry in 1949 and has been zero-ing in on the food handling field ever since, particularly vegetable-drying and candy-making plants.

G. B. Lewis Co., reinforced plastics tote box manufacturer of Watertown, Wis., has also made a specialty of the food field, supplying boxes to meat packers, wineries, canneries, fisheries, and catering firms. Both Lewis and Molded Fiber Glass Tray also supply the chemical and pharmaceutical industries.

Another volume item for Molded Fiber Glass Tray is a work drawer wherein students of home economics classes can store their materials. Along these lines, Kingston Products Corp., thermoplastic tote box supplier of Kokomo, Ind., has made a specialty of boxes for use in schools. Kingston also offers boxes for home economics classes, as well as school laboratories, gymnasiums, and school cafeterias. In addition, Kingston manufactures Cycolac boxes for use as hypo baths in photographic work. These trays are seamless, lighter than the metal pans commonly used, and do not lodge dirt.

Since plastics boxes last longer than wood or metal without maintenance, they offer a greater value in the long run regardless of the application. Naturally, they are most attractive to the end-user where the plastic does a unique job.

While sales figures on plastics tote boxes are difficult to pin down, an idea of the field's potential can be gleaned from a prediction by A. W. Levenhagen, president of Molded Fiber Glass, who says that his business will increase at least 10% a year for the next ten years.

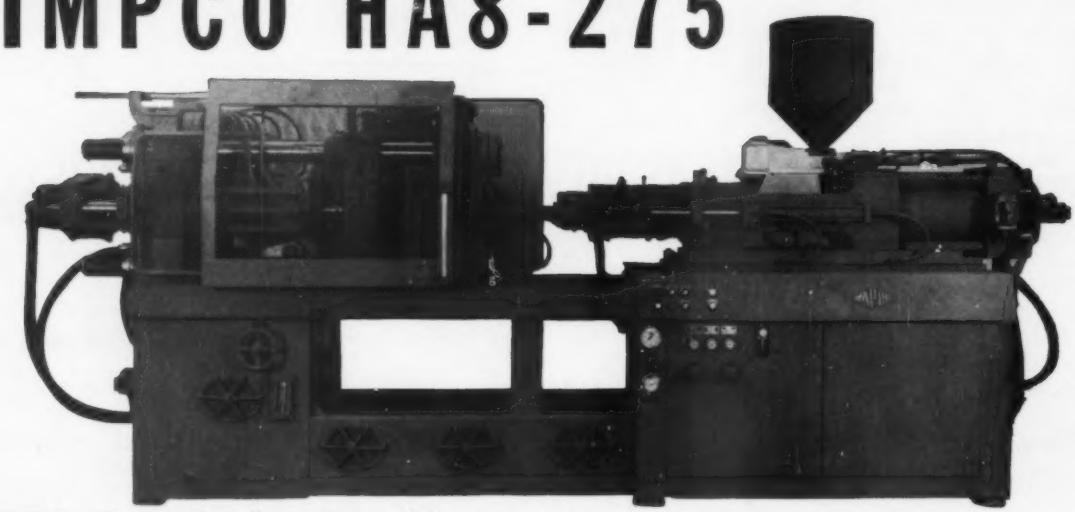
With all their superiorities, why don't plastics tote boxes sweep the world? There are three realistic answers to this question. One is high heat; some plastics won't take it. Another is original cost. The third, by far the most important, is education. People just don't know enough about plastics tote boxes, and the manufacturers, with limited sales forces, do not have the financial resources to tell them, though the raw material suppliers keep working at it.

To quote L. W. Leonard of Mercury Plastics Corp., Chicopee, Mass., manufacturer of thermoplastic boxes: "Our major obstacle is the lack of publicity given to plastics tote boxes and trays. A large number of potential users are unaware of the impact strength of plastics and the low-cost tooling required. Unfortunately, the word 'plastics' still brings to mind an easily broken toy and tooling costs of $2000 and up."

Mr. Leonard, we are doing our best.

And oh yes—to substantiate the reference to pickles in the first paragraph: Regal Plastic supplies a deep drawn box that handles a full bushel of cucumbers for a firm in New Orleans.—END

IMPCO HA8-275



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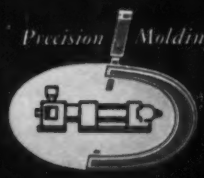

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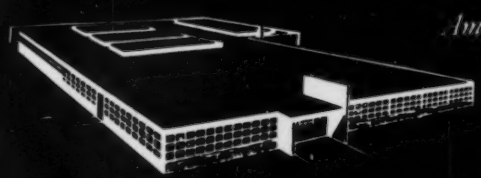

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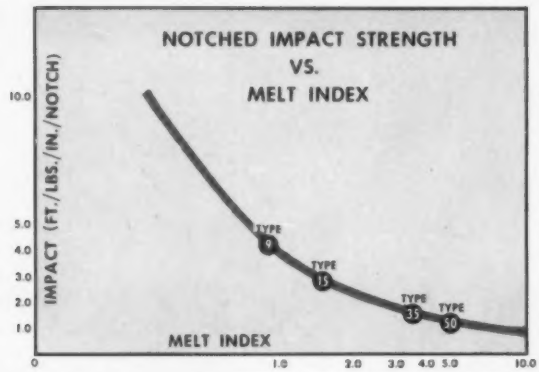

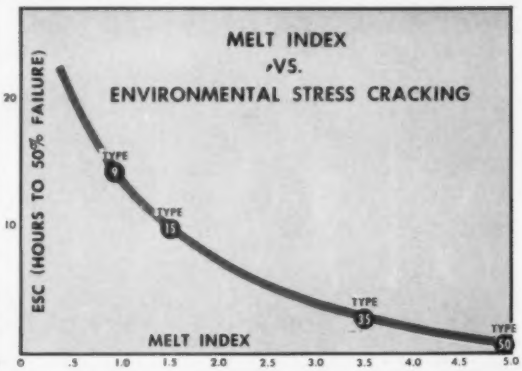

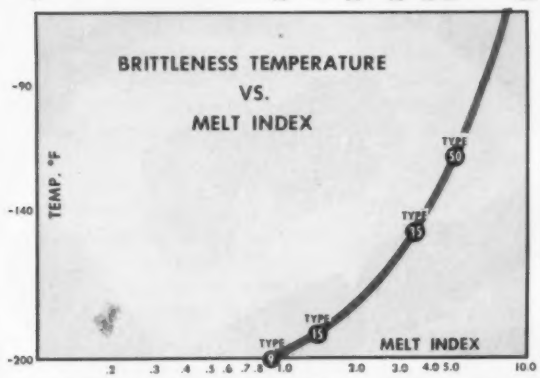

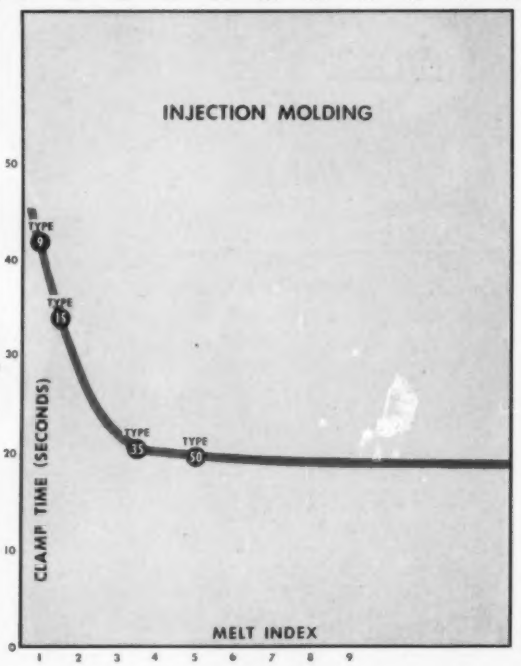

Typical Properties of Marlex 50 Polyethylene Resins

TYPE	9	15	35	50
Melt Index	0.9	1.5	3.5	5.0
Density	0.96	0.96	0.96	0.96
Softening Temperature, F.	260	260	260	260
Brittleness Temperature, 50%, F.	<−180	<−180	−150	−100
Impact Strength, (½ x ¼ in. bar), ft.-lbs./in. Notch	4.0	2.5	1.5	1.2
Tensile Strength (20 in./min.), psi.	4400	4400	4400	4400
Elongation, %	25	20	15	12
Stiffness, psi.	150,000	150,000	150,000	150,000
Hardness, Shore D.	68	68	68	68
Environmental Stress Cracking (Bell Laboratories Test), F_{50}, hours	14	10	2	1

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This new Sales Service Laboratory at Phillips Research Center in Bartlesville, Oklahoma, is equipped with all the latest plastics research and production equipment. Here, experienced engineers are developing data on new processing techniques and product applications, available to you through your local MARLEX sales representative.

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TYPE 9 is the toughest of the four resins. Type 9 offers the maximum in resistance to impact, low temperature embrittlement and environmental stress cracking.

TYPE 15 processes more easily than Type 9. The slightly higher flow of Type 15 is accompanied by a limited reduction in impact strength and environmental stress cracking. Overall characteristics are good.

TYPE 35 is useful for moderate resistance to impact and sustained stress such as in thin wall disposable containers and moldings of large area.

TYPE 50 is a high-flow material available for applications demanding the maximum in processability. Its relative degree of toughness requires that each application receive thorough testing in service.

For broader opportunities in the design and fabrication of plastic goods, four versatile types of MARLEX 50 polyethylene are now being offered to the industry.

These materials have been developed for general molding, extrusion and other methods of plastics processing. They are designated in order of increasing melt index as MARLEX 50 polyethylene Type 9, Type 15, Type 35 and Type 50. Type 9 is essentially identical to and replaces the single MARLEX 50 resin type previously offered.

As you can see in the accompanying graphs and table, increases in melt index have the general effect of increasing processability and reducing resistance to environmental stress cracking, percent elongation and impact strength.

All of these new types of MARLEX 50 polyethylene meet the same high standards of purity and uniformity established by the original MARLEX 50 resin.

Commercial quantities of all four types of MARLEX 50 can now be ordered through our district offices. Our sales engineers will be happy to furnish you complete data on these new MARLEX 50 rigid polyethylene resins, as well as processing and application suggestions.

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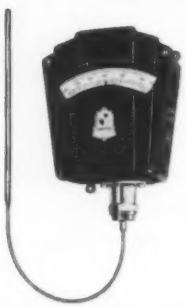

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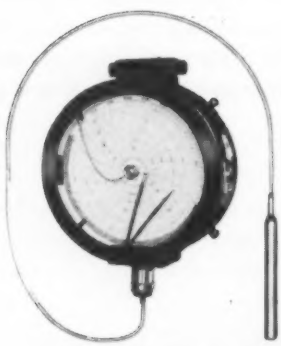

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Auto trim

(*From pp.* 112-114)

increasing acceptance of these covers is based on the growing realization by car owners that their new "dream" upholstery is beautiful but not necessarily durable and soil-resistant. The clear vinyl covers, customarily made of 12-gage material, protects new car upholstery without hiding its beauty. At 6 to 7 yards of material per set, the industry is said to be consuming an estimated 300,000 yards of clear vinyl sheeting per week for this application.

Another of the newer materials to gain attention of replacement auto trim producers is so-called "breathable" vinyl, which has already won acceptance in the furniture field as well as for original-equipment automotive upholstery. One such material is a vinyl-coated cotton fabric made by U. S. Rubber Co. and known as breathable Naugahyde. The vinyl is spot-deposited on the backing in a pattern determined by the design of the applicator roll; the design permits air to pass through the cloth at all points not covered by the plastic coating. The material tailors well and combines comfort, beauty, and cleanability.

Vinyl-coated cloth and vinyl-cloth laminations find extensive use in seat covers, head linings, arm rests, and door panels. A typical vinyl-coated stock produced by Landers Corp., Toledo, Ohio, is made by spread-coating a cotton backing with vinyl. This durable 18- to 20-oz. per sq. yd. material has a soft hand and excellent flexural properties. Southbridge Plastics Div., Golding Bros. Co., Inc., New York, N. Y., makes use of special vinyl and adhesive formulations to overcome earlier problems of poor adhesion and cold cracking in the production of vinyl-cotton laminations. Laminate seat covers fabricated from this material have been tested to minus 40° F. without cracking.

Jason Corp., Hoboken, N. J., specializes in laminating, embossing, printing, and quilting vinyl film and sheeting, which it sells to seat cover manufacturers and jobbers. Among the fabrics stocked is Jason Fabriseal, a vinyl-cotton knit back lamination offered in 37

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colors. Made in 16-oz. weight, the material tailors well, thanks to the stretchable cloth backing.

Prefabricated combinations of materials give the trim shop operator greater range of design treatment and make it possible to incorporate new functional features in auto seat covers. One such product, supplied by Bolta Products Div., General Tire & Rubber Co., consists of an elastic Boltaflex vinyl face sheet electronically sealed to vinyl foam and a fabric backing in a quilted construction. Known as Bolta Foam-Quilt, this material lends a luxury look to interior trim installations. Having all of the washable, easy-to-care-for features of regular vinyl seat cover materials, this product can be combined with any other material, including clear vinyl, in making seat covers.

Jason recently introduced Flight-Backs, a new product enabling custom trim shops to produce "Continental styled" seat covers rivaling luxurious original car upholstery. Made with a heavy vinyl face, reinforced with knit cloth, these are preshaped, padded panels that can be quickly and easily sewn on seat covers with standard sewing equipment. Their design includes a built-in piping effect which automatically creates a smooth finished edge.

A new type of seat cover said to be almost as easy to install as donning a pair of gloves is the "Show-Off," produced by the Fry-Duluth Co. and sold through Firestone stores and dealers. Made in long-wearing transparent blue or green vinyl material, they have elastic anchor straps and hooks which facilitate installation and insure a tight fit.

For do-it-yourselfers

Another interesting auto trim development by Jason, designed primarily for do-it-yourself installation, is the Beauti-Door. Retailed in sets of two, this is a three-color door upholstery replacement panel made in one piece, eliminating stitching or complicated handling. The panels, measuring 32 by 50 in., are sold in three color combinations. They are made up of electronically quilted Jason Sealtuft, having a heavy vinyl sheet face and clear

vinyl backing with a layer of non-woven felt-type material sandwiched between them. These units retail at about $3.75 per door.

Fabrication of auto seat covers and door trim panels involves large quantities of piping, welting, and other trim accessories. Novelty Bias Binding Co., Plastics Div., Chelsea, Mass., makes a complete line incorporating woven narrow fabrics, vinyl-coated fabrics, and vinyl films and extrusions. More recent trends in auto interior decoration, this company states, have led to the use of clear Mylar polyester welt, both extruded and stitched. Novelty offers this material with low cold crack properties, uniformity of size, and excellent clarity.

In addition to seat covers and interior trim, other major activities of auto trim shops include replacement of convertible tops and rear windows. Many of the materials used in convertible tops consist of vinyl-coated fabrics laminated to cloth, giving color and weather resistance to the outer surface. Convertible rear windows are made of heavy-gage transparent press-polished vinyl sheeting.

One supplier of this material, Southbridge Plastics, recently introduced a new giant size sheet of 40-gage vinyl for this application. Measuring 55 by 110 in., the sheet permits cutting of one-piece wrap-around rear windows for newer convertible models. Previously, it has been necessary to stitch two or more sections together for windows of this size. The bottleneck came in the equipment used to press-polish the big sheets; Southbridge installed a larger press to meet this marketing problem. Convertible windows made of the company's Vinylon material are guaranteed for a year against cold cracking and discoloration due to weather.

The importance of merchandising in replacement auto trim operations is illustrated by Rayco Mfg. Co., Paterson, N. J., largest manufacturer in the auto seat cover business. Rayco's chain of franchised stores includes some 150 retail outlets. Backed by national advertising, Rayco's current line consists of about 5000 seat cover sizes and patterns in open stock; some 400 new ones are added each year. This inventory brackets every major make of car on the road. Covers are fabricated at a central plant and distributed to retail outlets as required. Minor variations in auto seat dimensions are adjusted at time of installation by specially trained installers. Rayco employs a full-time seat cover designer, Michael J. McCarthy, to keep the company abreast of latest styling trends.

Early this year, ASCMA launched a $150,000 advertising and public relations campaign to stimulate sales of seat covers. Theme of this program, first of its type in the industry's history, was "Good Car Keeping Begins with Beautiful Seat Covers." It included a series of five advertisements in *The Saturday Evening Post*, backed up with window display materials, ad reprints, radio and TV spot announcements, and an illustrated booklet on good car keeping tips.—END

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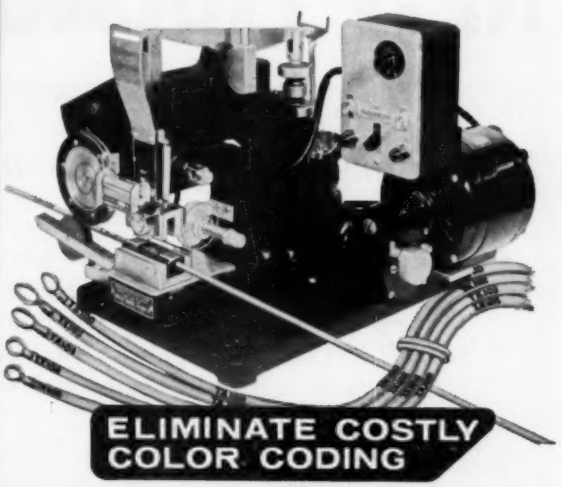

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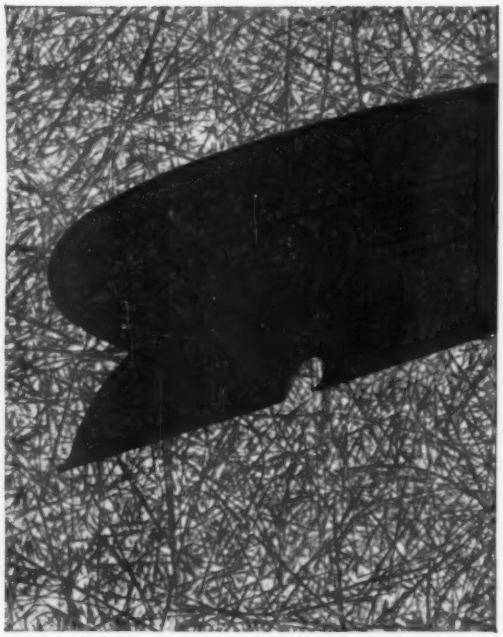

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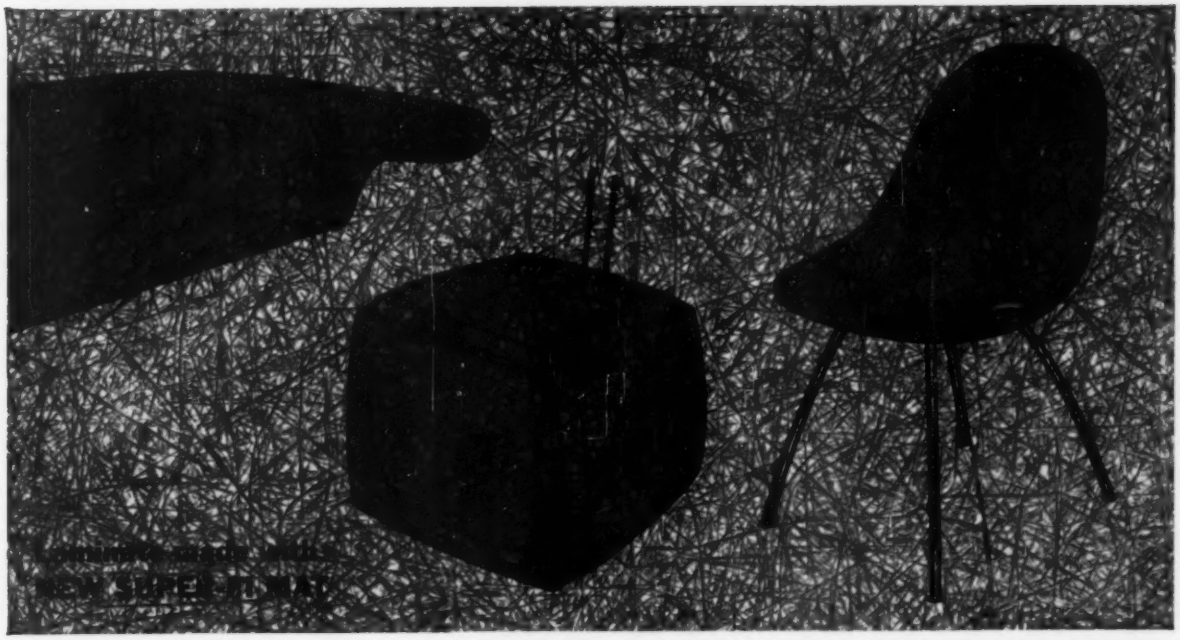
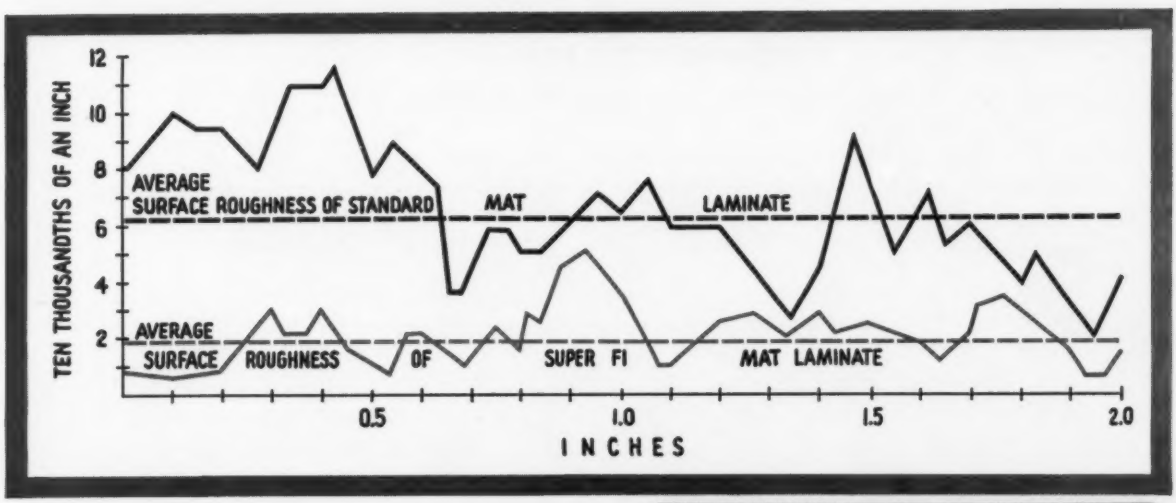


in the manufacture of reinforced laminates

ROVING AND MAT



SURFACE SMOOTHNESS CHART shows roughness pattern of laminate made with standard mat (solid black line) and corresponding pattern of laminate made with new SUPER-FI Mat (solid red line). Average surface roughness with SUPER-FI Mat (dotted red line) is 70% less than average roughness with standard mat (dotted black line).

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Toy is true

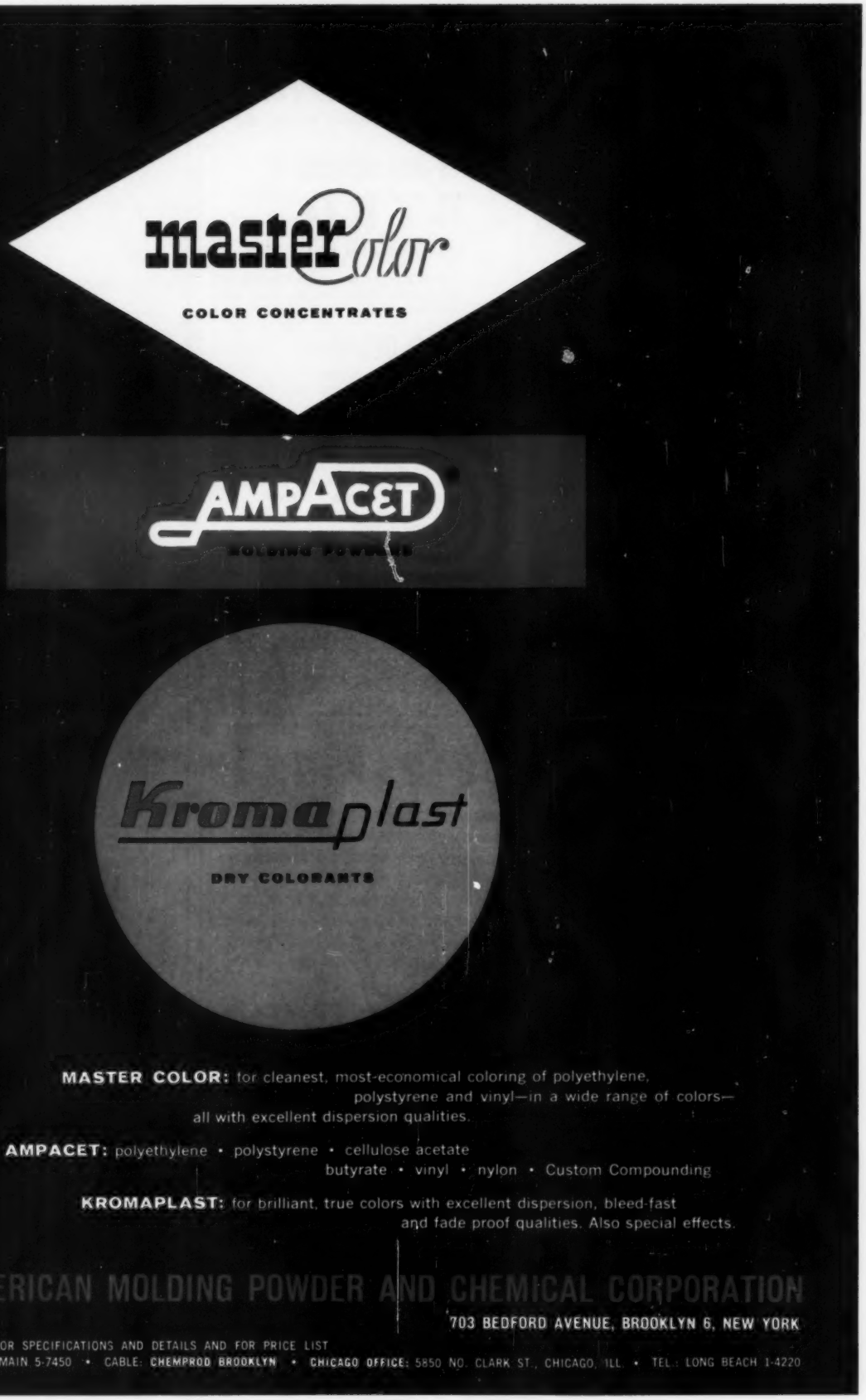
(*From p. 115*)

made of high-density polyethylene, as were those in the German model. BW tried to mold the blades out of standard polyethylene, but found that the helicopter simply would not fly. Laboratory tests with stroboscopic lights indicate that, at high speeds, the more pliable polyethylene developed a rippling effect, ruining the carefully engineered aerodynamic shape of the blade. The company returned to the original formula.

One important change that BW did make, however, was to double the strength of the safety lock which holds each blade within the rotor hub. Tests indicated that the rotor blade, when whirling at full speed, pulls against the hub with a force of 400 p.s.i. This almost equalled the shear strength of the rotor base, which acted as a safety catch within the hub. BW modified the base so that it would withstand at least 800 p.s.i., eliminating any chance of a flying rotor blade pulling loose.

In addition to the special high-density polyethylene for the rotor blades and hub, regular polyethylene is used for the tail fin, high-impact styrene for the fuselage, wheels, and passengers, clear styrene for the canopy, acetate for the launching mechanism, and nylon monofilament for the pull-string used to rev up the rotor blades. In addition to the plastics parts, over 16 metal components and two rubber bands go into the construction of the new vertical-flight toy.

The helicopter, with an 18-in. rotor span, is shipped in a fold-up box with two of its rotor blades disengaged. Assembly requires approximately 5 min. and is somewhat complicated. Once put together, however, little or no skill is required to fly the craft. An extension of the rotor axis fits into the hollow stem of the launching mechanism. A strong pull on the nylon monofilament brings the helicopter blades up to speed, and away it goes. A twisted rubber band is used to rewind the nylon filament in preparation for the next flight of the craft.—END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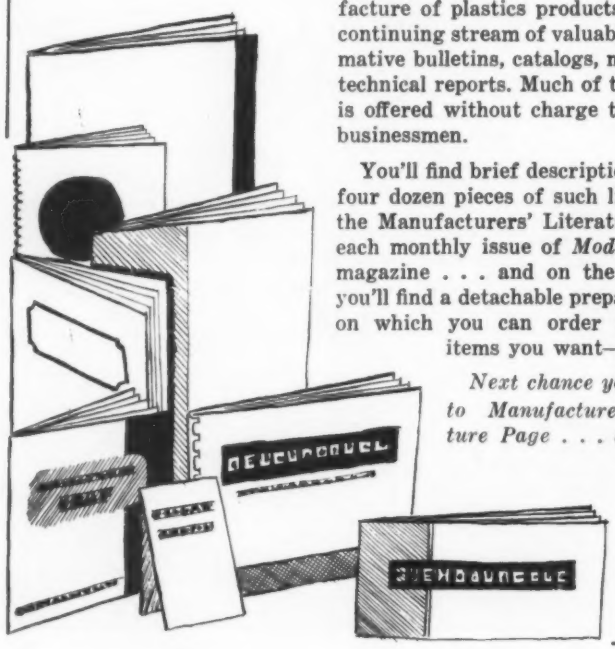

Raincoat

(*From pp.* 116-118)

to cracking when the covering was whipped by wind. After 14 months, it became apparent that a nylon-PVC fabric would stand up to every test demanded by the Army. Sindars felt he was ready to put the cover into production.

Three sections, one zipper

But it was not to prove that easy. The Army had one more request to make. Now that a strong, comparatively lightweight covering had been developed to protect the missile on the launching platform, Ordnance asked that the same sort of protection be provided during field assembly and transportation. The problem, however, was that during this period the missile is gripped by two large clamps, so the covering would have to be put on in three sections, to be zippered together after the missile is on its launching platform and the clamps removed. But this change was not to affect the ease with which the single-piece cover could be unzippered and removed.

The ingenious method used to get around this problem involves the use of polyurethane foam pads, plus exterior straps and buckles, which provide waterproof seals on each side of the clamping rings. When the clamps are removed, the pads hold the sections in place while they are zippered together. The vertical zippers on the two bottom sections are then opened (see drawings) and the long zipper-extension from the upper section is inserted. The result is an array of three parallel zippers, one of which extends in an unbroken piece from the tip of the missile down to the ground.

The tendency of the cover, of course, is to fall away as soon as a part of it has been opened, jamming the zipper on its way down. To stop this action, Sindars has developed a clam-shell construction for the nose cone, using two sections of reinforced phenolic joined by a flexible hinge of neoprene and PVC. The hinge, located opposite the zipper open-

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ing, lies on a slant (see drawing), causing the two rigid half-shells to "hang" in a closed position, gripping the nose cone, until the moment when they are opened by a pull on the fabric from down below.

The design of this nose-cone clamp created a difficult fabrication problem. The phenolic-glass sections require heat for their cure, but this has to be accomplished at the same time that the sections are integrally bonded to the thermoplastic materials of the flexible hinge. The solution was found in a complex mold that heats one section while cooling another, and by the use of a unique bonding agent that alloys itself both with the thermoplastic resins and with the thermosetting resins.

Similar ingenuity was required in the construction of the zippered openings leading to service ports in the missile skin. These ports generally consist of two doors which swing outward, and flaps incorporated in the covering hang from the open doors to form a three-sided shelter that keeps the rain out of the missile's interior.

Throughout the development of the Corporal cover Sindars has worked closely with the Jet Propulsion Laboratory and with Firestone Rubber Co. (prime contractor for the construction of the Corporal). In fact, all patent applications relating to the cover have been in the joint name of Airconductors and the Jet Propulsion Laboratory. But one measure of Sindars' contribution to this outstandingly successful application of plastics is the fact that Airconductors, still a comparatively small company, produced the covers on a direct prime contract with the Army's Redstone Arsenal. It is proof that even in the big business of missiles there is room for a small company with ingenuity and brains.

Credits: Irvington Varnish Div., Minnesota Mining & Mfg. Co., supplied the nylon-vinyl fabric; General Tire & Rubber Co., the polyurethane foam; Coast Mfg. & Supply, Livermore, Calif., the phenolic-glass materials for the nose cone.

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Color, APHA	50 max.
Odor	Faint
Specific Gravity, 20/20°C	0.972 ± 0.003
Free acidity, as acetic acid	0.01% max.
Ester content	99.0% min.

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Low-cost

(*From pp.* 120-122)

tooling for stator vane assembly in place of steel resulted in annual savings of 80 percent. The vanes, consisting of a base and an airfoil vane, are welded together. The positioning must be extremely accurate. Epoxy molds were cast, and the positioning airfoil guillotines for the welding fixture were cast into these molds. Tool replacement time was reduced 80 percent.

Dowel pin holes

The alignment of dowel pin holes on many occasions has resulted in the necessity to jig-grind these holes because of a tool maker's "slip" or heat treat warpage. Plastics can remove this jig-grinding necessity. The holes can be rough drilled to an oversized dimension, all tool or die work completed, heat treatment performed, and the parts mated together and clamped. Epoxy casting resin is then poured around the dowel pin into the oversized holes. While time and cast savings that can be achieved by this technique vary of course with the individual application, they have been found in each instant to be significant.

Conclusion

General Electric has estimated that 20% of its conventional tooling dollars can effectively be applied to plastic tooling. The Component Manufacture sub-section had a 1% realization during 1956—expects to achieve a 10% realization during 1957 and to reach the goal of 20% in 1958.

A planned program of education and training in various phases of plastics tooling has been initiated by the company in order to assure maximum utilization of this low-cost, short-lead-time tooling medium.

Plastic, used wisely, is a good servant. The user, however, must be able to recognize its capabilities and its limitations. In this rapidly expanding field with new materials and methods, today's limitation may be overcome so that it is tomorrow's accepted practice.—END

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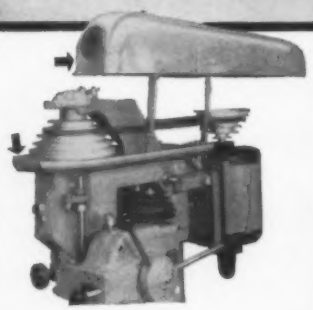

It's a top guard for a drill press

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MOLDED FIBER GLASS was chosen not only because it meets these requirements, but also because it *costs less*. Tooling costs alone for MOLDED FIBER GLASS are considerably lower than for drawn steel, which was also under consideration for this use.

The MOLDED FIBER GLASS top guard and pan fit together to form a protective cover for the cone pulleys and spindles of the 20-inch drill press, which is manufactured by Delta Tool Division of Rockwell Manufacturing Company. Both MOLDED FIBER GLASS parts are painted to match metal parts of the press.

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Plastics in solar

(*From pp.* 124-125)

formed from 50-mil, high-impact polystyrene and lined with aluminized Mylar film.

The second cooker, shown in Fig. 3, p. 125, was designed for recreational use. A folding reflector of aluminized Mylar laminated to a cloth-supported vinyl sheet is mounted on an umbrella frame, and the material is so cut and sewn that the axial cross-section of the opened reflector, along the centers of opposite panels, is parabolic. The surface of this cooker has a slightly lower reflectivity than the rigid reflector and a considerably lower concentration ratio, but by making its diameter 54 in. instead of 43 in., the same cooking rates are achieved as with the rigid-reflector type.

Reflecting surfaces

Both aluminized Mylar and silvered cellulose acetate butyrate film can be obtained with sufficient thickness to give good mirror-like reflectivity. The Mylar was applied either by laminating it to the sheet before forming or by applying it as tape to the formed shell. After 1.5 years of continuous outdoor exposure at Madison, the reflectivity of the Mylar film reflectors, originally 87%, was still about 60%, the loss apparently being due to clouding of the film. This material was used in the fabrication of all of the complete solar cookers. The silvered butyrate film was considered because of its excellent weathering characteristics and formability, but during forming there was some reduction of reflectivity due to parting of the silver layer, which was rather thin. Heavier silvering would probably alleviate this parting.

Rigid shells

Some shells were made of a glass-reinforced polyester resin, by hand layup, using both woven cloth and mat. Aluminized Mylar tape was applied to these. The resin was Selectron 5003 with MEK peroxide catalyst and cobalt naphthenate (6% cobalt) accelerator, using styrene monomer as a reactive viscosity reducer. The shells were cured at room temperature on open, spun-aluminum, parabolic molds. Shells were about ⅛ in. thick and weighed between 3 and 4.5 lb., the lighter cloth-reinforced shells being stiffened with radial ribs. Both types were molded around a stiffening peripheral rim of ⅜-in. aluminum tubing. Fabrication of each shell took two man-hours.

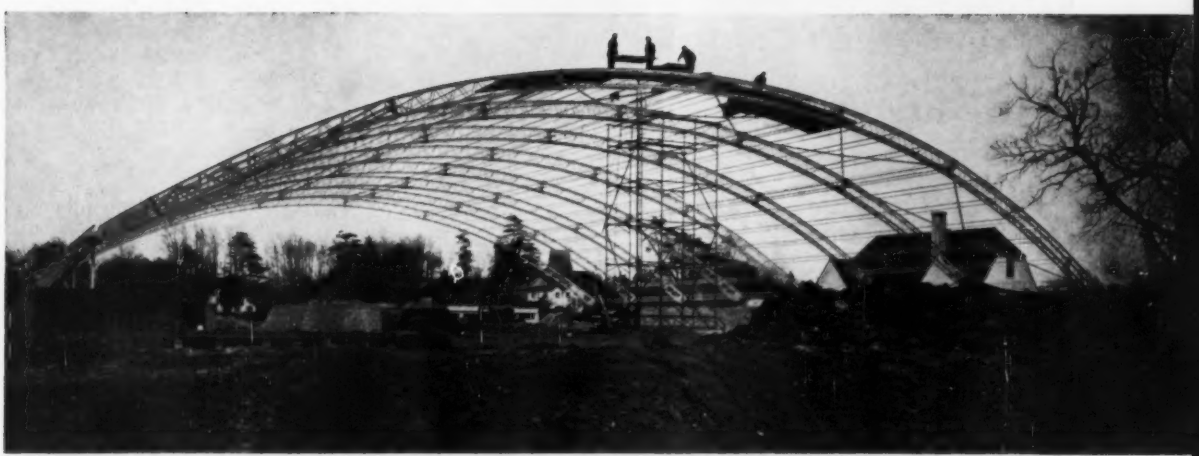
The high-impact polystyrene shell, suitably protected against sunlight by the reflective coating on one side and paint on the other, appears to be the most promising shell material. Both vacuum and drape forming were tried, each having advantages. Vacuum forming gave pieces having minimum reduction in thickness at the outer edge, thus providing the greatest stiffness where it is most needed. Drape forming results in more reduction of thickness at the rim but has the advantages that laminates can be heated from the nonreflective back, and that stiffening ribs can be formed in the shell in convex rib molds. Figure 2, p. 124, shows a ribbed shell coming out of the mold.

Rims of ⅜-in. aluminum tubing were attached by heating the edges of the formed sheet and rolling the plastic around the rims, or by cementing with a caulking compound that adheres to both aluminum and polystyrene.

The dimensional stability at elevated temperatures of sample pieces of 50-mil formed material was checked by heating in an oven at 175 to 185° F. for four hours. No measurable return to the original (flat) shape was observed at the lower temperature, but the sample at 185° F. had partially flattened.

Concentration ratios of about 300 are easily obtained in shells made of either material. Higher values of concentration ratio could be obtained but are undesirable in cookers.

The good weathering characteristics of cellulose acetate butyrate, and the ease with which it can be formed by vacuum or drape molding, led to trial of this material in 20-, 30-, and 40-mil thicknesses for reflector shell



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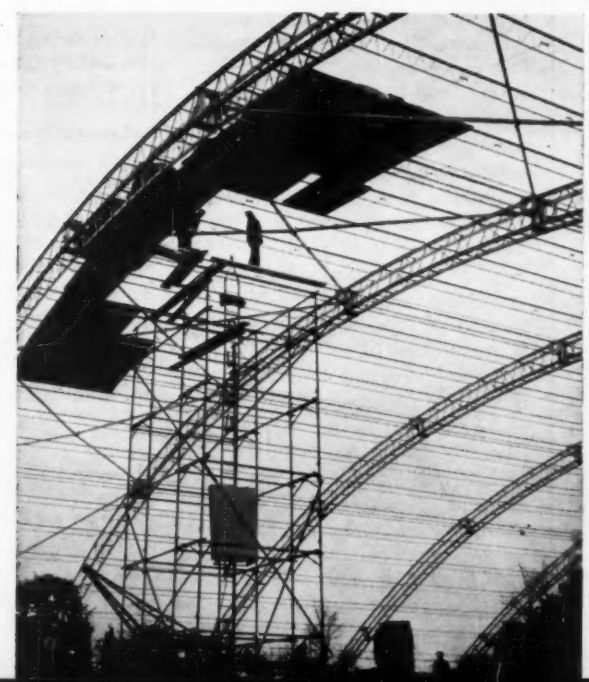

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construction. Clear and silvered butyrate were both used in vacuum forming experiments, the clear shells receiving a lining of aluminized Mylar tape. The rims of the formed butyrate shells were stiffened with aluminum rims as were the polystyrene shells, and radial ribs were formed in some. Unfortunately, the resultant shells, with or without the ribs, were found to be unsatisfactory because of their inability to retain parabolic shape, and because material costs proved to be excessive for cooker purposes.

Collapsible shells

The collapsible-type reflector, shown folded in Fig. 4, p. 125, was made by laminating 0.5-mil aluminized Mylar film to Fabrilite—a cotton-supported vinyl—or to a light-gage rayon cloth. The Fabrilite laminate has excellent strength, reflectivity, and crease resistance. The rayon laminate is lighter and strong enough, but its weave shows slightly on the aluminized surface, causing some impairment of the mirror-like reflectivity of the surface. However, both of the laminates are considered to be satisfactory for the purpose.

Since umbrella ribs will assume the curvature into which they are forced by their cover, the shaping and assembly of the reflective segments dictate the contours of the reflector. Between ribs the material is taut so that while parabolic radially, it is polygonal in the circumferential direction. The reflector is therefore made up of narrow, wedge-shaped, cylindrical parabolas that intersect along the ribs and at the center of the reflector. The segments must be cut according to pattern, then machine-sewn to form a roughly circular assembly. The reflector is then stitched to the tips of the ribs at the outer ends of the fabric seams. To obtain high concentration ratios with this kind of reflector, i.e., 50 or more, requires that none of the wedge sections be very wide, so about 16 ribs are necessary. Standard 16-rib umbrella frames with 18-, 24-, and 29-in. ribs give reflector diameters of 34, 45, and 54 in., respectively. At 70% reflectivity in direct sunlight, the corresponding heating rates are 260, 660 and 960 watts.

Pot must be black

The cooking rates of solar stoves also depend on the ability of the cooking vessel to absorb heat and on its rate of loss to the surroundings, particularly by evaporation. With suitably blackened and covered containers, a quart of cold water can be brought to a boil in about 15 min. on clear days with either the 54-in. folding cooker or the 43-in. rigid cooker. These cookers can broil hamburgers or steak in from 10 to 20 min., and they have been used for baking by simply placing a small oven over the focal zone.

Cost

The cost of manufacturing the rigid plastic cookers has been estimated at from $5 to $8, depending on the design details. The flexible cookers can be made for between $7 and $10. Fabrication of the flexible reflector may possibly be accomplished by drape or vacuum forming of the vinyl-Mylar (or other) laminate, then fastening it to the rib tips. This would reduce the cost. It may also be practical to metallize the molded shells directly rather than by applying metallized film, or aluminum foil might be laminated to the shell.

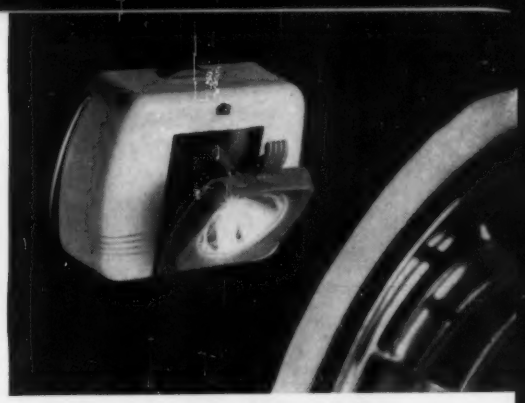
Aside from cooking, these reflectors are useful, or could be useful as heat sources for absorption refrigeration units and for low-pressure steam generation in non-industrialized areas, and for flash-measuring equipment.[3]

Acknowledgment

The work reported above was carried out with the support of the Rockefeller Foundation, the University of Wisconsin Experiment Station, and the National Science Foundation. The advice of Prof. Farrington Daniels has contributed a great deal to this study, and Mr. D. C. Dunham did much of the design work on the rigid-shell cooker.

[3]See "Epoxy parabolic mirrors," by P. B. Archibald, MODERN PLASTICS 34, 116 (Aug. 1957), which discusses a rotational method of casting parabolic mirrors for measuring the flash intensity of nuclear explosions.

QUOTED FROM CARL W. SUNDBERG, I.D.I., Detroit.



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Indonesia, Djakarta-Kota	Messers. N. V. Agung
Italy, Milano	Usvico (Societa Industriale Commerciale)
Italy, Milano	Euramerica S.R.L.†
Japan, Tokyo	Percy Breen††
Japan, Tokyo	A. R. Brown, McFarlane and Co., Ltd.†
Korea, Seoul	Bando Trading Co., Ltd.
Malaya, Kuala Lumpur	Getz Bros. & Co.
Malaya, Singapore	Getz Bros. & Co.
Mexico, Mexico D.F.	*Celanese Mexicana, S.A.
New Zealand, Auckland	Hardie Trading Co. (N. Z.) Ltd.
Paraguay (offices in Montevideo, Uruguay)	Armando Bachmann Suc.
Peru, Lima	George Checkley
Philippines, Manila	Union Trade Distributor
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Spain, Barcelona	Extractos Curtientes y Productos Quimicos, S.A.
Sweden, Stockholm	Scandinavian Raw Materials††
Switzerland, Basle	Chemische Fabrik Schweizerhall
Taiwan (Formosa), Taipei	Dah Chung Trading Co.
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Affiliates of Celanese Corporation of America

For latest Celanese Plastics Information see ad on page 9.

Directionally

(*From pp.* 143-144)

can minimize the amount of machining and finishing required. There will be cases, however, where it will be necessary to perform one or several of the following operations:

Sanding or grinding. These operations will remove tool marks and may be used for trimming. Open-grit sanding belts or grinding wheels should be used at fairly low speeds. For roughing, No. 50 silicon carbide grit is used; for semi-finishing, No. 100 grit; for finishing, No. 150 grit. Where extra-heavy removal is wanted, No. 36 grit may be used. Feed slowly and avoid overheating.

Sawing and cutting. A table saw fitted with a diamond wheel is best for making straight cuts in epoxy-glass laminates. A segmented wheel with 40 to 60 grit, 100 diamond concentration, bonded by electroplated hard nickel, is recommended. These wheels are comparable in price to a carbide-tipped saw but have much longer life and will cut wet or dry.[1] Such a wheel is preferable to a bandsaw because the bandsaw blade will dull very quickly. If a bandsaw must be used, the type of blade used for cutting metal is about all that is available. The number of teeth per inch is chosen on the basis of thickness of the cut, as with metals. The blade speed should be between 3000 and 4000 ft./minute.

Milling. In milling glass-reinforced epoxy, solid carbide or inserted carbide tools must always be used. The zero-degree rake shown in Fig. 1, p. 143, is recommended for all tools except solid carbide end mills, which are used as manufactured. Horizontal milling at high speeds with a heavy feed provides a very versatile operation that produces excellent surfaces.

Shaping. Technique is like that used for cast iron. In taking a through cut, first cut in from both edges, then remove center stock, using a fairly slow stroke;

[1] These wheels are supplied by four companies in the U.S.: West Coast Diamond Tool Co., Beverly Hills, Calif.; O'Rourke Diamond Co., N. Hollywood, Calif.; Hickerson Supply Co., Los Angeles, Calif.; and Lou Rosen, Los Angeles.

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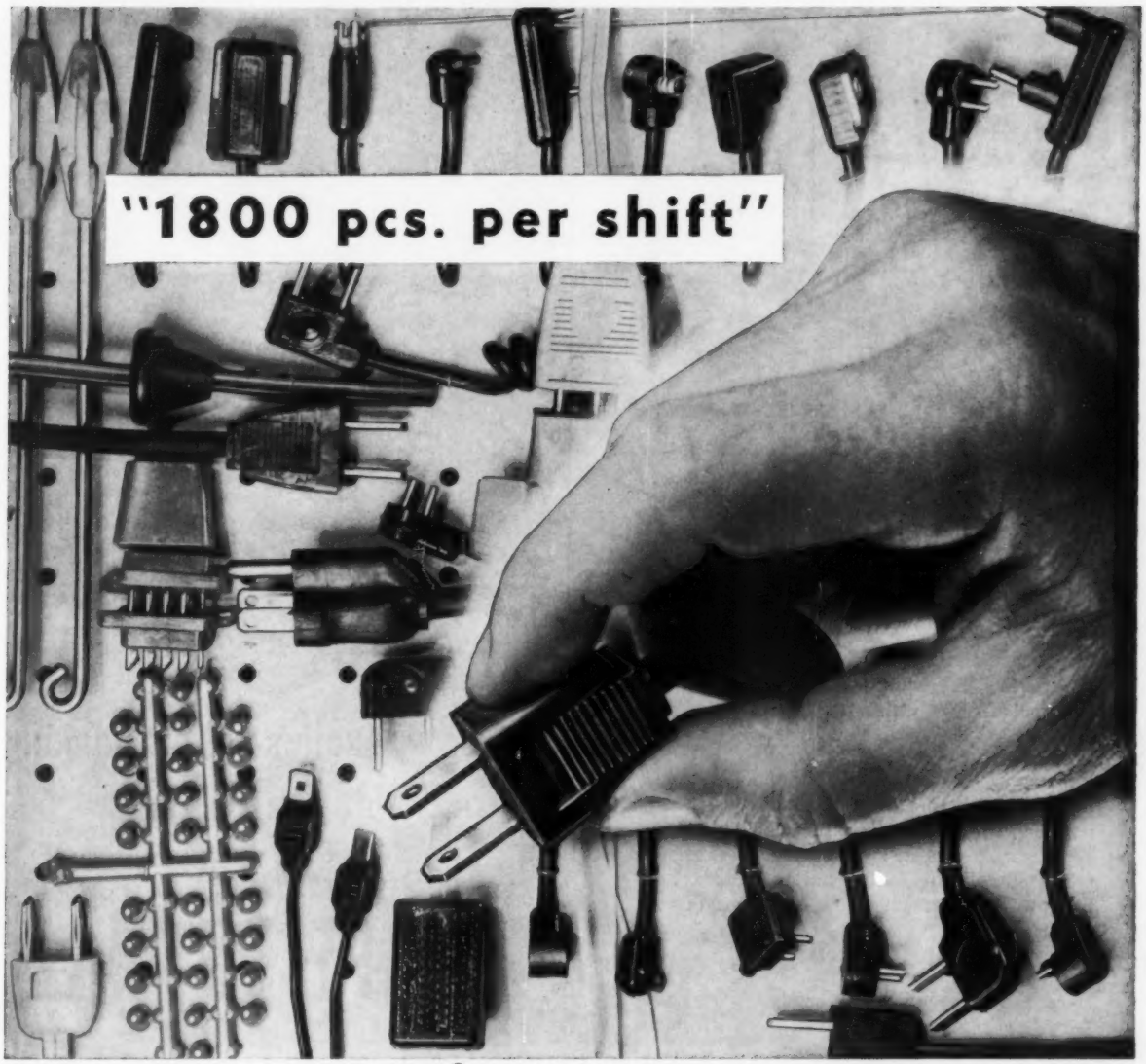

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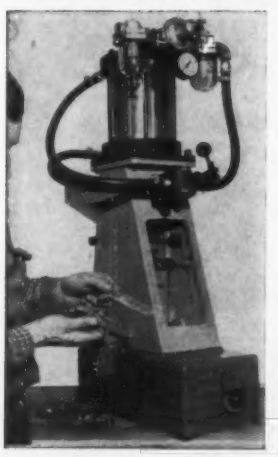
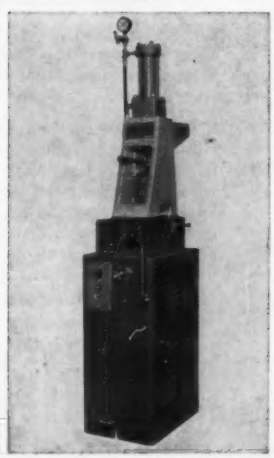


Model 45 "Wasp" (air)



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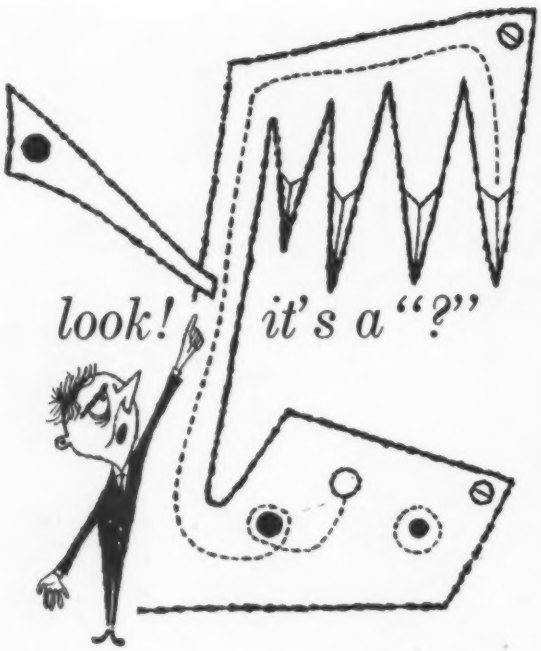

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tools, as in milling, should be carbide—grade C-2 is best.

Turning. Best results will be obtained by handling the reinforced epoxy as you would a grained wood. Tools should be solid or inserted carbide, with a partially rounded nose. The heel should be fed into the work at a high turning speed and with a heavy feed.

Drilling. For clean, sharp holes, a tightly clamped backup plate of wood or metal should be used when drilling perpendicular to the planes of reinforcement. To eliminate the small possibility of splitting when drilling parallel to the reinforcement planes, the material should be clamped between plates.

Tapping. Start with a larger hole than is ordinarily drilled in metal, since sharp thread edges will tend to chip off in use. For machine tapping, a two-flute machine tap will yield best results. As in drilling, the laminate should be clamped when it is being tapped parallel to the reinforcement planes.

Decorating

Scotchply laminates may be decorated by overlaying a pigmented sheet. Most colors are available. A smooth glossy painted finish may be obtained by the following procedure:

1) Sand surfaces lightly with a fine-grit paper to remove any surface gloss and mold release.

2) Apply one coat of filler or a lacquer primer-surfacer, and dry.

3) Wet-sand with "Wetordry" Tri-M-ite paper, 320 grit.

4) Visually inspect the surface. If any voids can be seen, repeat the filler and wet-sanding steps as necessary.

5) Apply one or two coats of lacquer or enamel, drying and wet-sanding between coats.

If it is desired, a wax coating may be applied after 30 days of air drying. An example of the results obtainable by this procedure is the Convert-a-Frate refrigerated cargo unit of the Rock Island Railroad system which was described and illustrated in an earlier issue of this magazine. (see MODERN PLASTICS 34, 110, April 1957.)—END

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"We get the most consistent with Pittsburgh Fiber Glass

. . . says Mr. Forrest Engelhart, President, Automatic Plastic Molding Company, Berkeley, California

"Plastic products reinforced with fiber glass account for 50% of our business," reports Mr. Engelhart. "Our major product is safety helmets, but we also produce file drawers, film developer trays, kindergarten chairs and battery cases.

"Here's how our production improved when we switched to Pittsburgh Fiber Glass Roving as a reinforcing agent:

1. IMPROVEMENT OVER FORMERLY USED MATERIAL

"The reinforcing material we previously used was not Fiber Glass and could not pass the water absorption test, would deteriorate with age and weather, and we could get only one color with it. Pittsburgh Fiber Glass Roving eliminated these inadequacies.

2. UNIFORMITY CUTS REJECTS

"We used Pittsburgh Type 500 and Type 508 Fiber Glass Roving with chrome finish. We must obtain a critical mixture to assure product strength. We find Pittsburgh Roving to be the most consistent in uniformity, and rejects have been reduced to less than 2%.

3. HELMETS MEET NAVY SPECIFICATIONS

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Screen with three helmet forms is removed from pre-form machine. Two-inch Pittsburgh Fiber Glass Roving is forced on screens by suction. About 800 pre-forms are produced per man each 8-hour day.

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Helmets are weighed and inspected before shipping. Weight specifications must be within one ounce tolerance. Helmets meet strict Navy specifications, thanks to Pittsburgh Fiber Glass Roving.

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Forming sharper

(*From pp.* 152-153)

box (Fig. 2), with the corner dies in retracted position. The sheet should be heated to normal forming temperature, about 360° F.

2) Turn on vacuum to draw sheet into the box.

3) Swing the four corner dies simultaneously downward to form the corners (Fig. 3) and clamp them in place.

4) Lower the male mold into the box and clamp in place (Fig. 4).

5) Release vacuum. Allow part to cool below forming temperature before removing the mold (Fig. 5).

Possibilities

Although the work to date has been concentrated largely on ¼-in. sheets, the technique should be equally successful on other thicknesses. However, for acrylic sheets thicker than ¼-in., the corner molds will probably have to be operated hydraulically or mechanically because the forces required will be so large. For high production setups, mechanical and automatic actuation of the corner molds and the main plug may be worth considering.

This corner-forming technique, which may be thought of as a variant of plug-assist forming, should be just as useful in forming sheets made of thermoplastics other than acrylics, wherever relatively large forces are needed. The principle here is subdivision of the male plug so that the areas of greatest change in shape can be partly formed and cooled before the remaining areas are formed, thus distributing the elongation more evenly over the whole. Thus, with appropriate modifications of the plug components, the method may facilitate the forming of other shapes, such as waste baskets, that are difficult to mold or form from plastics of high melt viscosity. A very promising application of sheet thermoforming is luggage making, but corners have had to be generously rounded. The rounding is pleasing to the beholder but frustrating to the packer. Here, too, the new technique should be helpful.—END

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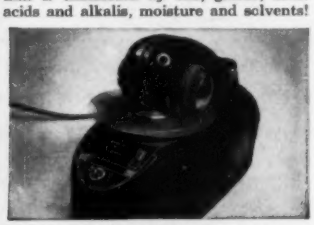

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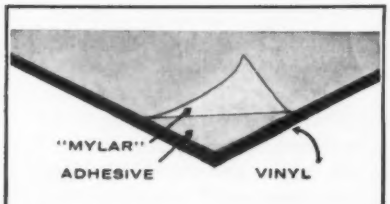

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RESULTS: "With BOLTA-TOP we were able to enter a growing market with a fast-selling new product," reports the Chief Development Engineer at Bolta's Lawrence, Mass., plant.

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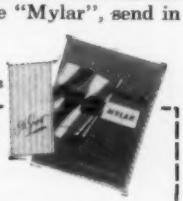

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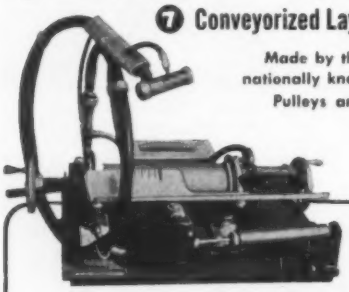

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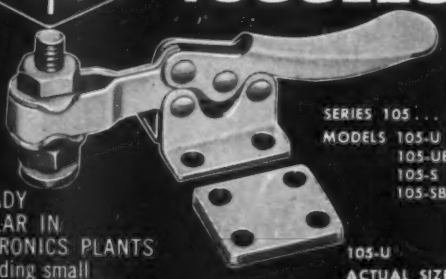

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And now plastics have entered the arena as directly competitive materials for packaging. In just the last few years they have come to play an increasingly important role—and often at the expense of older, "traditional" materials.

Especially noteworthy is the fact that plastics can be used in the manufacture of almost every basic package type: box, bag, bottle, drum, jar, vial or collapsible tube!

Right now this frontal invasion of the packaging field by alert plastics manufacturers, molders, laminators and fabricators has just begun. And their chief sales tools are the two publications which reach the men who make packaging decisions in all 45 industries—MODERN PACKAGING magazine, issued monthly, and the annual MODERN PACKAGING ENCYCLOPEDIA ISSUE.

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MODERN PACKAGING

575 MADISON AVENUE NEW YORK 22, N. Y.

Designing polymers

(*From pp.* 155-162)

by the skiving method. Teflon 5 was introduced for this purpose (Fig. 10); it has an average particle diameter of about 0.3 millimeter. Although the smaller size is not obvious because the scale of the micrograph is changed, you can see the fine particles now present from the cutting operation.

More recently, the needs of sheeting manufacturers for a physical form that would consolidate readily into even, pinhole-free sheeting has inspired the production of a still finer cut in the form of Teflon 7X (Fig. 11, p. 162). This now has an average particle diameter of only 1/200 millimeter.

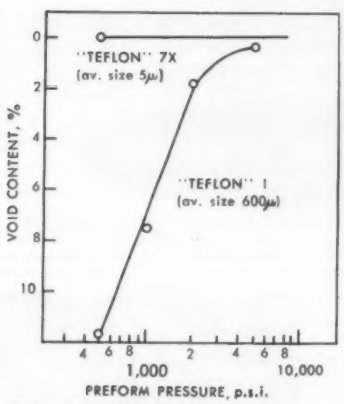

Fig. 12: Effect of particle size on consolidation pressure

The much finer, somewhat fibrous structure of 7X produces pinhole-free sheeting (Fig. 12) at 500 p.s.i. forming pressure in contrast to Teflon 1 which is not quite so suitable even with a 5000 p.s.i. forming pressure. In addition, 7X is now found by some processors to be preferable for tape billets and may perhaps be advantageous in other forms of processing as well.

In the discussion of polyethylene, allusion was made to the property control in the hands of the processor. In Teflon there is an even wider range of properties that cannot be pinned down by the materials manufacturer but are within the command of the

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Both sump and line types may be easily disassembled, cleaned and reassembled by any workman, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

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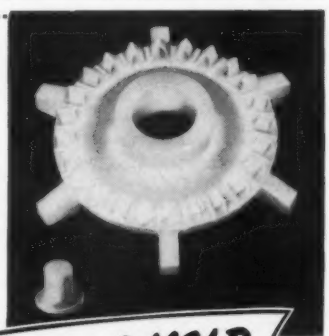

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That is why some of the country's leading manufacturers, like the Briggs and Stratton Corp., look to us for many of their precision-made parts. Pictured above is an oil slinger gear and stop switch button we molded for them of wear-resistant Zytel.* This superior plastic makes for quiet operation, and withstands extreme temperatures.

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process. This results from the fact that the crystallinity of tetrafluoroethylene resin is importantly affected by the temperature-time cycles involved in fabrication, particularly in the sintering operation. It is thus possible, in the fabrication of Teflon sheeting for example, to control the cooling cycle after sintering in such a way as to vary crystallinity over a significant range. The effect of this control on an important end-use property is exhibited in Fig. 13, below. This shows how the resistance of sheeting to damage by flexing, for material having a given degree of polymerization, depends on the amount of crystallinity that is produced in the course of the fabrication process.

This brief summary of some of the factors that may be involved in designing polymers for use as plastics may have raised more questions than it has answered. This seems to be inevitable in a field where sound, logical, basic knowledge is still in the formative stages. Nevertheless, an attempt has been made to illustrate in a high-spot way the kind and degree of modification produced by manipulation of chemical structure in past and current development work, and the partnership role of the processor in converting the inherent properties of these structures into the physical properties of plastics pieces that give them the essential end-use values which have been found to be so important in this plastics business.—END

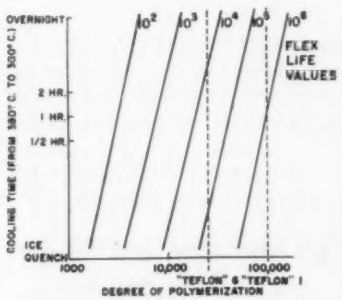

Fig. 13: Contributions of material manufacturers and fabricators to end-use value of 1/16-in. sheeting of Teflon tetrafluoroethylene resin

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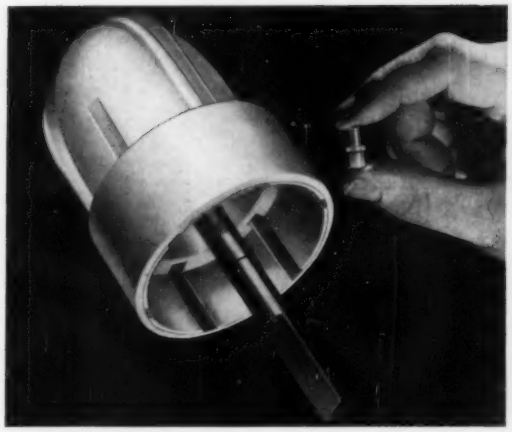

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TYPICAL LETTER FILL PROBLEM SOLVED, COSTS CUT

THE PART

A clear plastic dial had sunken numerals, molded on the reverse side. These were filled with white and a back-up coat of black then sprayed over them. As the numerals were too small to be individually masked, the area containing the numerals was blocked off and sprayed white. The white overspray was wiped off with a solvent soaked rag.

THE PROBLEM

Because the white smeared the area when wiped, three wipers were required for each sprayer. Different whites were tried and all smeared. In some cases they attacked the plastic. Others dried too quickly and required too much effort to remove. Production was limited to the rate at which the parts could be wiped.

THE SOLUTION

A Logo white dry wipe was offered. After the area was sprayed, it was allowed to set until dry, (less than 1 minute) three brisk wipes with a dry cloth and the part was clean. Two wipers were transferred and production requirements met. Parts were clean, numerals sharp and plastic free of haze.

DRY WIPE

Logo X-134 series of dry wipes are popular with those who letter fill plastics. If you have semi-skilled help and require an easy-to-handle quality "wipe in," write or call for literature and samples.

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Hydrostatic pressure

(*From pp.* 174-182)

pressure in order to increase the flow rate of the polymer may be self-defeating. For example, increasing the injection molding pressure on polystyrene may cause such a large increase in viscosity that the net increase in flow rate would not be worth the expense of equipment required to achieve the higher pressure.

5) Measurements of apparent viscosity by means of viscosimeters of various capillary diameters even when operating into atmospheric pressure will not give comparable results since the driving force for the various capillaries will result in subjecting the melt to different hydrostatic pressures.

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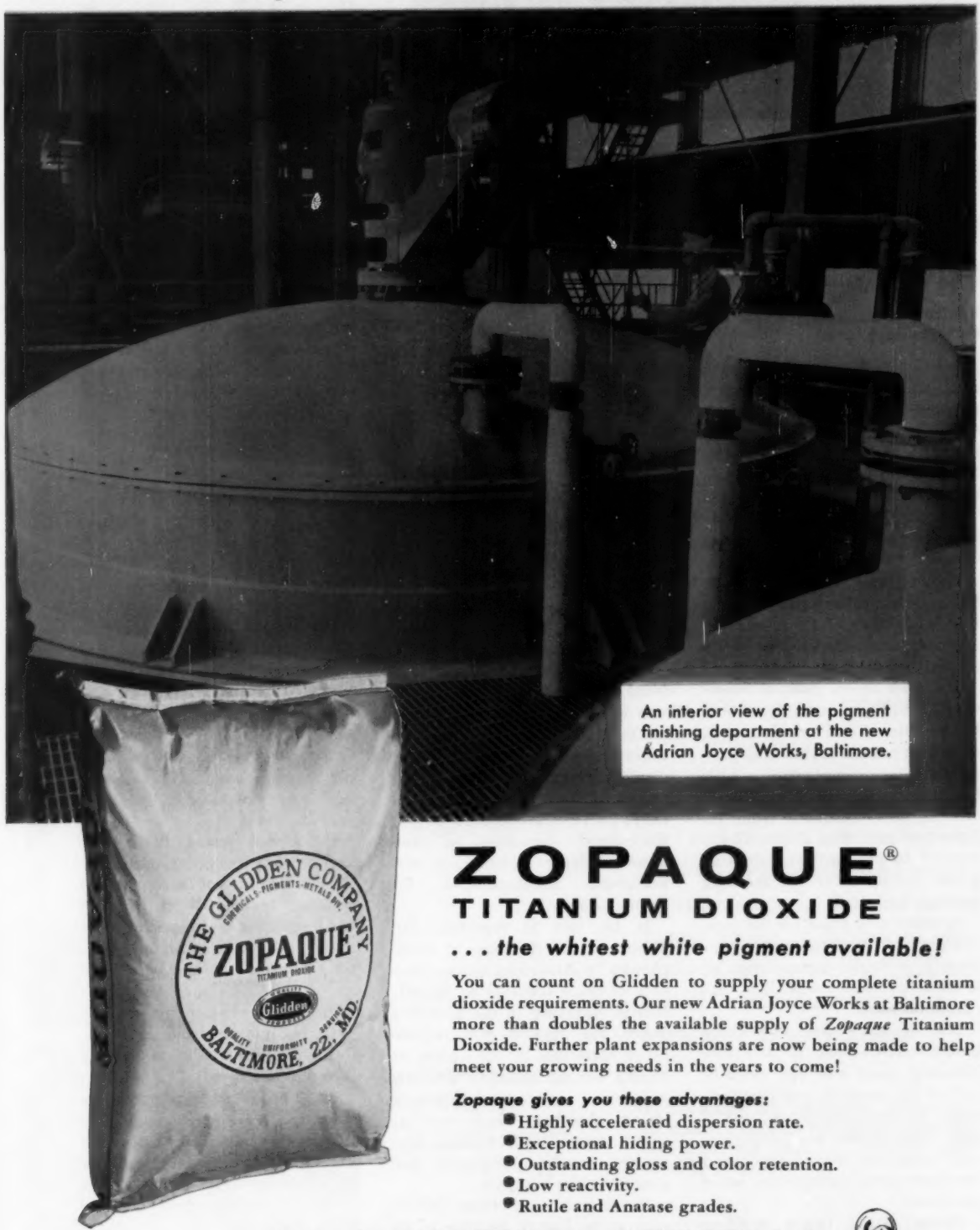

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 (*Section 1 starts on p. 39*)

Foster Grant expands as a material producer

Plans for a $5.4 million expansion of its styrene monomer, polystyrene, and nylon production facilities have been announced by Foster Grant Co., Inc., Leominster, Mass. The new expansion plans follow close on the heels of a $2.5 million expansion program currently being completed.

The styrene monomer plant, built at Baton Rouge, La., in 1954 with a capacity of 12 million lb., is being expanded again to a capacity of 105 million pounds.

The new nylon plant at Manchester, N. H., where nylon-6 will be produced and molded, will open this month. Nylon-6 is produced from caprolactam which has been widely used in Europe and is now available from an American producer. Foster Grant expects to produce an extrusion grade shortly after the molding grade is perfected.

Another new plant for the production of high-impact polystyrene is under construction at Leominster and will go into operation soon.

The company has also completed construction of a color-blending plant and has recently tripled its research and development facilities which include a pilot plant where semi-commercial quantities of copolymer and modified styrene resins are being produced.

Foster Grant began molding and fabricating plastics in 1919. Celluloid combs and hair ornaments were the first products. When cellulose acetate was introduced, the company was one of the first to develop injection molding with a machine based on a German original. In 1955, the firm began compounding acetate molding material from flake. Today Foster Grant claims to be the world's largest manufacturer of sunglasses, a producer of polyethylene squeeze bottles, and other polyethylene items, and is well remembered as the company that first produced the polystyrene case and dispenser for safety razors and blades.

However, the company's new plant for production of nylon-6 was the central point of interest at the recent Foster Grant press conference, where the company displayed many molded items produced from nylon-6 and introduced Dr. Carl Mienes, of Bad Godesberg, Germany, a well known plastics consultant and European representative for Foster Grant Co.

In his talk to reporters, Dr. Mienes stated that use of nylon plastics in American automobiles will increase ten-fold to 50-million lb. annually in the next five years. He says it will replace other materials in such parts as tubing for oil pressure and air suspension systems, dashboards, shock absorbers, lock mechanisms, motor cooling fans, door strikes, window channels, and possibly even bumpers.

He pointed out other future uses in packaging because of its grease resistance, and increased applications in gears and machine parts, film for raincoats, shoe heels and top lifts, and housings for appliances.

New nylon-6 injection compounds with a more uniform crystalline structure that can be worked with die temperatures between 80 to 120° C. will permit more rapid setting and thus increase production speed, said Dr. Mienes, and there will be no distortion after the article has been removed from the mold. Higher melt viscosity will facilitate manufacture of extruded and blown articles, such as tubing, pipes, film, and bottles, he declared. Furthermore, these higher-molecular-weight nylons show better resistance to hot water and can be used in the dairy industry where nylon pipe may be used to replace stainless steel. The new types may even be used for carburetor floats and gasoline cans because of their oil and grease resistance, Dr. Mienes added.

Dr. Mienes also discussed new equipment now being used in Europe. He told of a large-size injection molding unit with the plunger or ram replaced by a screw which allows a 40% increase of the platen size at the same closing pressure. It is particularly suited for molding heat-sensitive plastics. Another machine is a rotary thermoformer which manufactures drinking cups in six molds, each with 20 cavities. It operates on a 3-sec. cycle and can make 24,000 pieces per hour.

He further stated that extrusion is now being practiced for the manufacture of large pipes by winding extruded strips and welding them automatically. By this method long aluminum pipes on two rolls are slowly rotated on a movable carriage which passes the extruder die and an extruded plastic band is introduced between the aluminum pipe and the rolls.

Another piece of equipment, he said, will permit production of tubular film by a method in which the extruded film is not blown up by air but led over one or two revolving rings to give axial and cross stretching.

Iron screws, whirl-sintered with nylon, are now on the market, said Dr. Mienes. They don't corrode and their insulating quality is good. Whirl-sintering with polyethylene, nylon, and

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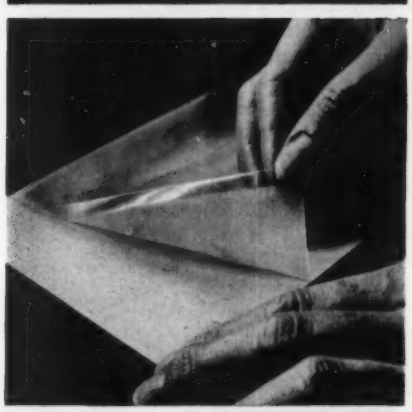

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The Plastiscope

chlorinated polyether is gaining importance also for coating of wired metal components, according to the speaker.

Bakelite increases vinyl capacity

Production of Bakelite's VYHH vinyl resin will be increased by 30% at new facilities now under construction at Texas City, Texas, and scheduled to go on stream in the spring of 1958 (See MODERN PLASTICS, 35, 37, September 1957).

VYHH is a copolymer of vinyl chloride and vinyl acetate. It is used primarily in long-playing records, floor tile of the vinyl-asbestos type, and coatings that are used for milk containers, beer can linings, and marine, masonry, and industrial finishes. This particular type of vinyl chloride formulation has been comparatively scarce several times during the past few years and Bakelite was the only producer until a few years ago. Now there are at least three other producers of similar resins. Estimated consumption of this type resin in 1956 included over 40 million lb. for floor coverings, well over 30 million lb. for sound records, and over 20 million for coatings. Except for its application in floor tile, VYHH does not generally require the use of a plasticizer.

Polyester plasticizer

Completion of full-scale production facilities for Eastman Chemical Co.'s new neopentyl glycol was marked by shipment of truck load quantities to a southeast producer of polyester plasticizers last month.

Polyester plasticizers are notable for extreme hydrolysis resistance and low migration. The new Eastman NP-10 glycol is reacted with a dibasic acid such as maleic to produce the plasticizer. The resultant plasticizer is generally blended with other plasticizers to obtain better non-migration properties in vinyl chloride compounds. NP-10 can also be used with isocyanate to produce urethane foam that will have improved tensile strength and shows less tendency to discolor than many current formulations; but it is higher in cost than the recently introduced glycol ethers used in polyether-isocyanate foam. NP-10 now sells for 37¢/lb. compared with the 45¢ price which was current during the development period.

New Associate Editors

To keep pace with the growth of the plastics industries and to render ever better reporting service to our readers, MODERN PLASTICS announces the appointment of two new Associate Editors.

Guy Bishop, educated in England, is a linguist of note. His background includes manufacturing, publicity, and sales in the plastics industries, lecturing here and abroad, magazine article writing in many countries.

As one of the pioneers in the urethane field, he helped to establish an industry society under the auspices of the Rubber Manufacturers' Association.

A. Cappiello

G. Bishop

Alfred M. Cappiello, graduate of Guilford College, Greensboro, N. C., and Master of Arts in creative writing from New York University, began his editorial career on the *Stars and Stripes*. On the New York *Journal of Commerce*, he was successively industrial and financial reporter, chief of the paper's Cleveland news bureau, and Plastics Editor.

ABS for hot water pipe

A combination of acrylonitrile, butadiene, and styrene—designated Kralastic HTHT—which can be made into pipe by extrusion or injection molding is going into production at the Baton Rouge, La., plant of Naugatuck Chemical Div., U. S. Rubber Co. In laboratory tests, boiling water and low-pressure steam have been carried in pipe made from the new material, which showed considerable strength at 220° F.

Further development work, however, will be needed before the new material is ready for the home plumbing market; a more immediate use is in radiant heating pipes. Tests are now being conducted for pipe used to carry hot acids and in molded parts exposed to high heat, such as ducts and housings in auto engine compartments.

Kralastic HTHT is claimed to be light in weight, corrosion resistant, and to resist swelling through water or chemical absorption. Its standard color is black, but it can be pigmented in a limited range of colors on special order.

Pentaerythritol plasticizers

Something new in plasticizers is the family being developed from pentaerythritol by Hercules Powder Co. Pentaerythritol derivatives are inherently inclined to be resistant to deteriorating influences such as heat and light—they are chemically stable. They are also generally less affected by water than comparable products derived from other polyols. Such properties are especially desirable for plasticizers used in vinyl chloride compounds.

Hercules now has two monomeric plasticizers derived from pentaerythritol. One is Hercoflex 707, the other Hercoflex 600. The former is the newer. It is now in full-scale production after several years of development and is essentially a premium item that is particularly effective for wire coating compounds that must withstand temperatures of 105° C. or more for prolonged periods of time. It is currently being evaluated for use in formulations other than those used in compounds for wire coating.

Hercoflex 707 is claimed to equal or better the performance of polyester polymerics in retention of physical properties after

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steps up product quality
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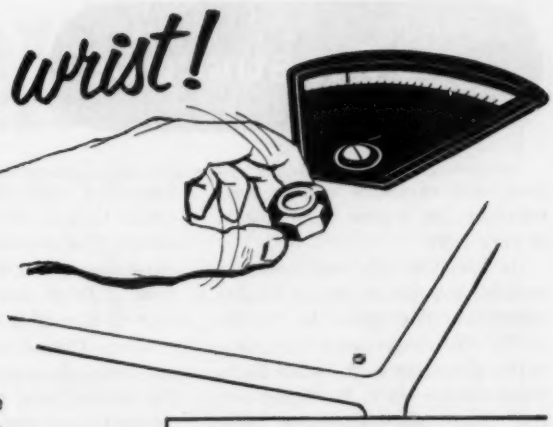

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Write for information on Sarcotrol Heating and Cooling Unit or special small Sarcotrol Unit for vacuum forming. Advise application.

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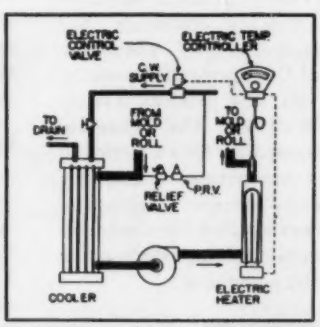
Sarcotrol Model MC-2 Heating and Cooling Unit for injection molds, cylinders, rolls, drums. Compact. Fully-enclosed. All control knobs, switches, indicating instruments easily seen, accessible.



Schematic diagram of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits. MC-3 has three circuits.

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1. **Simple, selective control**—single knob adjustment. Temperature control is of dial thermometer type; shows both selected and actual temperature.

2. **Unique temperature control system**—3 steps: two stages of heating; one stage of cooling. Sequence: temperature up, then idle, then cool. Utilizes one or two sections of a 6000-watt enclosed heating element.

3. **Pressurized water-circulating system,** using heat exchanger. Prevents accumulation of impurities by using same water continuously at pre-set temperature and pressure.

4. **Individualized heat exchanger adjustment**—large heat exchanger with cooling water flow control valve permits adjustment to individual application for best results.

5. **Higher temperatures**—by controlling pressures. Typical: 300°F water circulating at 60-75 psi.

6. **Water and electricity saved**—cooling water and power consumption dependent on demand. When temperature stabilizes, neither water nor power is consumed.

7. **Sensitive system reaction**—fast response (full, immediate cooling) insures maximum rate of heat absorption from material being worked. Ideal operating sequence for vacuum forming.

8. **Maintenance of correct temperature**—controls product quality.

The Plastiscope

prolonged exposure to high temperature. Its degree of migration is very low.

Its low viscosity and viscosity stability suggest its use for quality plastisols. The price is 52¢/lb., which offers economies over some of the plasticizers offered for high-temperature work. It should also find many applications in other than electrical compounds after its utility has been more thoroughly explored.

Hercoflex 600 is also comparatively new. Its properties are somewhat different than the 707 classification named above, but the price is lower at 42¢ a pound. It is an ester of pentaerythritol and a saturated aliphatic acid and can be used as a primary plasticizer for vinyl chloride, vinyl acetate copolymers, nitrocellulose, ethyl cellulose, neoprene, and chlorinated rubber in all proportions. In ratios up to 35 parts per 100 parts of resin, it is compatible with vinyl butyral, acrylonitrile rubber, and polystyrene. It is incompatible with polyvinyl acetate, cellulose acetate, GR-S, and methyl methylacrylate.

Like 707, the 600 type is notable for its permanence in a vinyl compound. It is not as good as 707 for the higher-heat electricals but is claimed to be permanent at temperatures of around 95 C., which is superior to many other plasticizers. Its viscosity is claimed to change less under temperature variations than most other monomerics.

In many cases, a plasticizer designed for low-temperature flexibility is so soft as to be useless at moderately high temperatures, and one designed to give good service under warm conditions is brittle at low temperatures. But Hercoflex 600 will reportedly give better than usual service at both high and low temperature extremes.

Hercules tests indicate that plasticizer loss in a 75-mil-thick vinyl sheet when heated at 100° C. for 96 hr. was four times less for Hercoflex 600 than for DOP. Other tests show that in a 4-mil-thick film containing 50 parts plasticizer per 100 parts resin, the loss of DOP was over 20 times that of Hercoflex 600.

When Hercoflex 600 is used as the sole plasticizer in plastisols, the latter have a relatively low viscosity and good viscosity stability. This characteristic permits either the production of harder, tougher end products or the use of more filler in the composition. Plastisols that use this material require a higher fusing temperature than those containing phthalate plasticizers, but the heat stability and non-volatility of the 600 type permit use of higher temperatures without ill effects.

Hercules now has eight plasticizers. Among the eight is di-*n*-octyl decyl phthalate from coconut oil, of which Hercules is a pioneer producer, di-*n*-octyl decyl adipate, and a high-molecular-weight polyester plasticizer which is designed primarily for polyvinyl acetate.

Styrex becomes Tyril

A name change in one of its major plastic molding materials has been announced by The Dow Chemical Co. Formerly known as Styrex 767, the product now is called Tyril 767. The renaming was prompted by Dow's desire to establish a separate identity for its family of styrene-acrylonitrile copolymers which differs basically in formulation from Dow's other plastics formulations.

Triple lamination

A new triple-lamination process, a highlight of the expansion of its Custom Laminating Dept., has been announced by Lamart Corp., Clifton, N. J. Equipment for dry-resin, heat-seal, and wet-emulsion bonding has been installed at the Clifton plant. Available triple combinations include cellophane with cellophane, cloth with cloth, paper with cellulose acetate or polyethylene, and vinyl with nylon or cloth. Mylar is bonded to paper, polyethylene, vinyl, or cloth; or backed with vinyl-coated woven and non-woven fabrics, paper or fabric impregnated with rubber or latex, etc.

The company also does standard or special embossing and printing and supplies self-sealing adhesive backings. The customer's own materials, or selections from Lamart's line of plastics and fabrics are utilized in laminations to exact specifications.

Another development announced by the company is metallized butyrate laminated on both sides with a clear butyrate film. A range of colors can be obtained by adding the desired coloring matter to the laminating adhesive.

The laminate, claimed to be a superior thermoforming material, is said to have greater rigidity than non-laminated butyrate of the same over-all thickness, permitting use of thinner gages. The material is supplied in rolls of various lengths, depending upon gage, in widths up to 40 inches.

Acetate up

A 3¢ across-the-board increase in the price of powder and flake cellulose acetate has been announced by Eastman Chemical Products, Inc., chemical marketing subsidiary of Eastman Kodak Co. Under the new scale, truckload quantities of most types of Eastman cellulose acetate will be 44¢ per pound. (The 1950 price was 48¢.)

Source for pyrrolidone

A complete line of vinyl pyrrolidone polymers and copolymers is now being offered by Stein, Hall & Co., Inc., 285 Madison Ave., New York, N. Y. The firm is equipped to tailor-make resins for specialty applications in the adhesives, coatings, and cosmetics fields.

Formica in England

Formica Ltd. has been formed as a subsidiary of Thomas De La Rue & Co., Ltd., London, England, to take over the manufacture and sale of all products handled by the Plastics Div. of the parent company. Under an agreement between American

U.S.I.

Vol. II, No. 6

POLYETHYLENE PROCESSING TIPS

RESIN PROPERTIES THAT AFFECT STRESS-CRACK RESISTANCE OF POLYETHYLENE

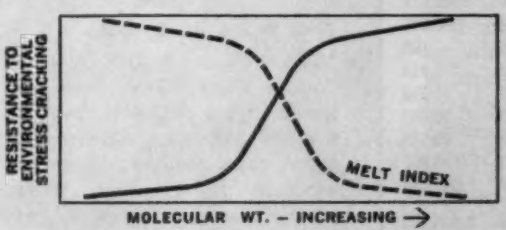
Environmental stress cracking is the term used to describe a certain type of material failure. With polyethylene this failure occurs when the plastic is under high local stress (either external or internal) and in contact with materials such as a soap, detergent, or solvent, which affects the polymer.

Resistance to stress cracking is especially important for applications such as electrical insulation, polyethylene pipe, housewares, and certain types of packages.

Two factors influence the resistance of a polyethylene part to environmental stress cracking: the resin used and the conditions used in fabricating the part.

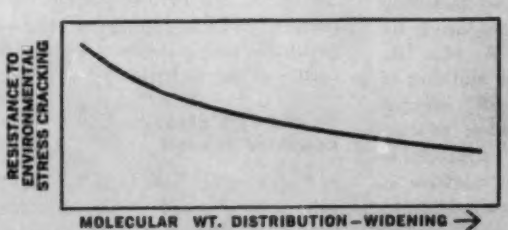
Which resin to use:

Stress crack resistance is greater with a resin of *higher molecular weight* – that is, lower melt index.



Then why not use low melt index resins? Because production rates are lower. The processor must make a compromise between peak production rate and top stress-crack resistance and use a resin that will be satisfactory, if not ideal, in both respects.

Molecular weight distribution of the polyethylene



resin is important too. Resins with a narrow molecular weight distribution (with fewer molecules much higher or lower than the average) have better stress crack resistance than those with wide molecular weight distribution (more of the larger and smaller molecules but the same average). The low molecular weight fraction is more susceptible to attack by environmental materials.

However, the flow properties of a polyethylene resin having a narrow molecular weight distribution and a given melt index are not as good as those of a polyethylene resin having a wide molecular weight distribution and the same melt index. Here again the processor must make a compromise between production rate and the properties he requires in the end product.

Density of the resin will also have an effect on the resistance of that polyethylene resin to environmental stress cracking. The higher the density, the poorer resistance to environmental stress cracking. On the other hand, the more linear or more dense polyethylenes have enhanced flow properties and higher stiffness and tensile strength.

There is no single answer to all problems

It is obvious from the preceding discussion that there is no simple solution to the selection of a resin for a particular end use. The resin must be carefully selected while giving proper consideration to the important end properties required in the fabricated article.

An answer to your particular problem can be found by obtaining a polyethylene resin from a manufacturer who can give you the balance of properties required – high or low melt index, narrow or wide molecular weight distribution, a range of densities. U.S.I. is one such supplier and their Technical Service Representatives stand ready to assist you in the selection of the proper Petrothene resin.

Processing conditions affect stress crack resistance

Processing temperatures, cooling rates, and other processing conditions can have a marked effect on stress crack resistance, because of residual strains left in the fabricated article.

There isn't room to go into these in detail here but the next issue of "Tips" will discuss them more fully.

Meanwhile if you have a specific problem, call on U.S.I.'s Technical Service Engineers. They will be glad to work with you toward finding a solution.

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The Plastiscope

Cyanamid Co., New York, N. Y., and Thomas De La Rue & Co., Ltd., an interchange of technical information will take place in the field of laminated plastics over the next 25 years. (American Cyanamid is the parent company of The Formica Co., Cincinnati, Ohio.)

A. G. Norman, managing director of De La Rue, has been named chairman of Formica Ltd.; G. G. Riddick is managing director.

Custom carbon blacks

Kenmix carbon black dispersions formulated to customers' requirements are now being offered by Kenrich Corp., Maspeth, N. Y. The dispersion, said to be compatible with vinyls and polyethylenes, is claimed to overcome the moisture problems generally associated with the use of carbon blacks.

PVC wire insulation

Wire in the new Convair 880 jet passenger liner will be insulated with Geon 8800, a polyvinyl compound especially developed by B. F. Goodrich Chemical Co. to meet the rigid requirements for jet aircraft wiring. The company claims that the compound, because of its good heat stability, has five times the insulation resistance of previously available materials over the full operating temperature range.

New pigment supplier

Entry into the pigments-for-plastics field has been announced by Carbic Color & Chemical Co., 451 Washington St., New York, N. Y. The firm, which formerly sold dyes for the textile industry, is now offering a complete line of pigments for all types of plastics.

The company is also a sales agent for Farbwerke-Hoechst, Frankfurt, Germany, and Hoechst Chemical Corp., West Warwick, R. I., producers of dyestuffs and pharmaceuticals.

Pigments sold by Carbic are presently produced in Europe. Plans for a pigment-producing plant in West Warwick have been formulated and the new facility is expected to go on stream by the spring of 1958.

Plastics in Europe

European sales of plastics materials for 1956 were nearly four times greater than in 1950 and 16% higher than in 1955, according to the Organization for European Economic Cooperation. The 1956 total for the 13 member countries was 2.6 billion pounds.

A breakdown of plastics production in European member countries is shown below:

Country	*1956*	*1955*
	1000 lb.	*1000 lb.*
Austria	28,660	21,605
Belgium	39,903	36,596
Denmark	3,748	2,866
France	286,404	225,222
Germany	1,078,049	964,106
Ireland	1,455	168
Italy	318,086	275,348
Netherlands	76,678	57,253
Norway	20,648	19,850
Sweden	78,925	69,445
Switzerland	41,887	33,951
U. Kingdom	687,174	641,759
Total	2,661,617	2,348,169

For better esters

A new inhibited decyl alcohol that yields improved esters and may, at the same time, substantially reduce manufacturing costs, has been introduced by Enjay Co., Inc., 15 W. 51st St., New York, N. Y. The addition of the inhibitor protects alcohol during the esterification process and prevents any appreciable color formation. The additive is removed from the ester during the course of normal purification and no special treatments are required. Since the inhibitor is removed in normal processing, the resulting ester retains its good electrical properties, according to Enjay.

In addition to improving the quality of the resultant ester, it may also effect important economies. In many cases it will be unnecessary to further decolorize the ester (with carbon black) to obtain a product which has a very light color.

Plastisol with Shore "A" 100

A plastisol compound reported to fuse to a Shore "A" hardness of 100 has been developed by Rubber Corp. of America, Hicksville, N. Y. The formulation couples low viscosity with high hardness when fused.

Translucent figures for lamps for children's rooms are currently being cast of this material. Other possible applications are: 1) casting of reproductions of art masterpieces; 2) manikin forms; 3) top coating for vinyl-coated fabrics; 4) tool handles; and 5) coating for rolls and pulleys used in business machines.

R C Rigid Plastisol is available in drum quantities at 46¢ to 51¢/lb. in assorted colors. The compound can be adjusted to suit individual processing requirements or to meet special performance characteristics.

Five types of Cycolac

Marbon Chemical, Div. of Borg-Warner Corp., Gary, Ind., now has five types of Cycolac molding material available. Cycolac "R" is for parts requiring maximum hardness and rigidity, tensile strength, and resistance to heat distortion. "T" gives toughness at high hardness levels. "H" offers high impact and is suggested for sheet as well as moldings. "L" is used for extruded pipe and tubing, profile extrusions, and calendering. A low brittle point is its feature. "LT" has good low-temperature properties—it is non-brittle at 65° F. below zero.

Reinforced plastics standard issued

A Commercial Standard for Reinforced Plastics Corrugated Structural Panels, CS214-57, has been issued by the U. S. Department of Commerce. Developed over the past several years by the Fiberglass Reinforced Panel Council of The Society of the Plastics Industry, Inc., and the Plastics Section of the National Bureau of Standards of the Com-

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merce Department, this Standard covers methods of test for bearing load, transverse load, flammability, appearance, and color uniformity. It is the tenth Voluntary Commercial Standard on Plastics.

A hydrocarbon useful in plastics

Commercial production of a new hydrocarbon, 3-ketobutyaldehyde-1-dimethylacetal (KBA), has been announced by Henley & Co., Inc., 27 Spruce St., New York 38, N. Y. KBA is claimed to be a good solvent for many organic products and to serve as an intermediate in the synthesis of plastics.

Akron polymer lectures

The Akron Polymer Lecture Group, which holds periodic meetings at the University of Akron under the auspices of the University, has listed the following subjects for 1957-1958:

"Some new aspects of ionic polymerization." (December 6).

"Coordination polymers." (January 3).

"Molecular motion and physical properties of rubber and plastics." (February 7).

"Lexan polycarbonate resins." (March 7).

"Nuclear magnetic response and mechanical properties of polymers." (April 11).

"Rheology of dilute polymer solutions." (May 9).

PVA in packaging

Reynolon, a water-soluble, transparent polyvinyl alcohol film available from the Plastics Div. of Reynolds Metals Co., is offered as a packaging material for soaps, detergents, fertilizers, paints and tints, anti-rust agents, insecticides, and other water dispersable products.

While providing product protection during shipping and storage, the new film eliminates the bothersome step of opening the package and the messy hands that usually result. For example, in the case of detergents, the housewife can simply drop the unopened package into the washing machine where the film will dissolve, releasing the detergent into the wash water.

Polyvinyl alcohol film was originally placed on the market four or five years ago, particularly as a package for bluing used in wash water, but not much has been heard of it since that time, except as a release agent for polyester laminates.

Cary starts production of vinyl chloride

Completion of a new plant at Flemington, N. J., for the production of polyvinyl chloride resins and other chemicals has been announced by Cary Chemicals, Inc. Production capacity was stated to be approximately 12 million lb. annually. The plant was built by Scientific Design Co., Inc.

The PVC resin from the Flemington plant will be used in the manufacture of vinyl compounds at the company's E. Brunswick, N. J., plant and also marketed directly to various industrial consumers of vinyl resins.

Vinyl tile colors restyled

Complete color restyling of its Lifetime vinyl floor tile line, based on two years' investigation of consumer and decorator color preferences, has been announced by Robbins Floor Products, Inc., Tuscumbia, Ala. New Colors have been introduced and items which have proved successful in the past have been realigned to broaden the company's line, which includes marbleized, terrazzo, and solid tiles.

Silicone resin laminate

Commercial quantities of a silicone resin for bonding low-pressure structural laminates are now available from Dow Corning Corp., Midland, Mich. Designated R-7141, the material was specifically developed for the vacuum molding of complex structural parts. It is said to provide high strength at elevated temperatures, good thermal stability, and low dielectric losses.

Applications include radomes, aircraft duct work, and high-temperature missile parts.

Improved pipe lining

A new saran lining for pipe, valves, pumps, and fittings used by industry in handling corrosive liquids and gases has been announced by The Dow Chemical Co. The lining is claimed to expand and contract to approximately the same degree as steel casing, making possible its use in a wider range of temperatures. Dow recommends the lining for service from below zero up to 200° F.

This development, together with the recent availability of saran-lined centrifugal pumps, makes complete saran-lined piping systems possible.

Distribution will be handled by Saran Lined Pipe Co., Ferndale, Mich. Manufactured by Dow, standard stock sizes of pipe, valves, pumps, and fittings with the new lining are available from inventory.

Mylar-vinyl laminate

A laminate of metallized Mylar and rigid vinyl in 0.010 to 0.0175 gages is now available from Coating Products, 101 W. Forest Ave., Englewood, N. J. It is offered in 54-in. width rolls or cut-to-size sheets in chrome, gold, or copper in plain, perforated, or embossed patterns.

The lamination is suggested for applications requiring rigidity. According to the company, the material can be pressure-formed for dimensional effects or handled with the workability of light-gage sheet metal for grilles, panels, and other industrial parts.

Finishing compound destaticizes

Buffing compounds that eliminate or reduce static charges on plastics are now available from Hanson-Van Winkle-Manning Co., Grand Rapids, Mich. The compounds are used in the standard buffing operation (removal of

Dow announces

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TYRIL

the new family of Dow
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The Plastiscope

parting lines, surface defects, excess paint, etc.). Buffing is necessary to this destaticization method; without buffing, the compound has no effect.

The compound is available in liquid or solid brick form and in three grades for medium and heavy cuts, for high-color work, and for acrylics.

Selective solvent

A new industrial solvent for use with ultra-sonic cleaning equipment which offers selective solvency, electrical stability, rapid drying, safety, and low unit cost has been announced by London Chemical Co., 1535 N. 31st Ave., Melrose Park, Ill. Designated Sonic-Solve #113, the solvent is claimed to remove contaminants, rosin fluxes, oils, greases, and dirt without affecting plastics, magnet wire, insulating varnishes, etc.

According to the company, the non-ionic, non-hydroscopic liquid is completely stable and safe for use with electronic cleaning equipment. It dries rapidly in open air or in an ultra-sonic dryer. No rinsing or neutralizing is necessary. Sonic-Solve #113 is non-flammable and has a minimum toxicity of 500 ppm. in air in an 8-hr. working day.

Inert gas improves extrusion

Nitrogen blanketing of polyethylene extruder feed to minimize oxidation and help solve such problems as gels, fisheyes, and dark spots has been recommended by the Tuscola, Ill., Technical Service Laboratory of U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp. It is reported that if the air is excluded by so blanketing the feed hopper, the frequency of such defects is reduced. Nitrogen was chosen because it is low in price and readily available.

A further refinement of the procedure is to blanket the molten polyethylene with an inert gas as it leaves the extruder, to reduce build-up of oxidized material on the die lip of the extruder. According to the company, the same principle is applicable to other methods of processing polyethylene, such as molding.

Boron catalyst

Commercial quantities of diborane (B_2H_6) are now available from Callery Chemical Co., Pittsburgh, Pa. It can be shipped as a compressed gas, stored indefinitely at low temperatures, and handled safely with suitable precautions.

Applications include use as a catalyst, intermediate, and reducing agent. For example, polymerization of ethylenically unsaturated compounds, such as methyl methacrylate, vinyl acetate, chlorotrifluoroethylene, and butadiene, is catalyzed by diborane.

Full-color printing on polyethylene

Designing and printing of polyethylene bags in full-color rotogravure has been announced by Milprint, Inc., Milwaukee, Wis. Claimed to be the first commercially successful application of rotogravure on polyethylene, the initial production was a carrot bag for Merit Packing Co., Salinas, Calif.

Initial reaction has been favorable and the package has been effective in stimulating sales. Extension of this method to other products is anticipated.

Hostalen gets Canadian okay

All grades of Hostalen, a low-pressure-processed (Ziegler-type) polyethylene produced by Farbwerke Hoechst, has been accepted under the Canadian Food and Drug Act, according to an announcement by Hoechst Chemicals Co., a Div. of Canadian Hoechst, Ltd., Toronto, Ont.

The company also announced the availability of a special polyethylene pipe compound known as Hostalen GM-5010. This compound is claimed to have an expected service life of 50 years, comparable with expected steel pipe life spans. It is non-toxic and can be used for potable water.

Catalysts for isotactic polymers

Titanium dichloride and trichloride in multi-pound quantities are now available from The New Jersey Zinc Co., 160 Front St., New York, N. Y. These products are considered promising catalysts for isotactic polymerization of unsaturated hydrocarbons, such as ethylene, propylene, and butene.

Both materials are free-flowing, dark purple, crystalline powders. Introductory prices of $5 to $10/lb., depending upon quantity, have been established for titanium trichloride, and $15/lb. for titanium dichloride. These development products are available through the firm's Metal Div.

Versatile plasticizer

DP-200, an ester-type compound produced by E. F. Drew & Co, Inc., and distributed by Harwick Standard Chemical Co., is suggested for use where low-temperature flexibility combined with good heat and light stability, low heat loss, and low volatility are desirable. Applications include general vinyl compounding; vinyl film for drapes and curtains, upholstery, fabric coatings, and artificial leather; plastisols and organosols; as well as synthetic rubbers.

New line of butyrate sheet

A new proprietary line of extruded butyrate sheet for thermoforming has been announced by Joseph Davis Plastics Co., 450 Schuyler Ave., Arlington, N. J. The sheets are 22 in. wide and from 7½ to 30 mils thick; 5-mil butyrate sheet may be obtained on special order. The standard sheet is transparent, but colors may be had on special order.

Blowing agent

A blowing agent for rubber and plastics, based on hydrazine, has been developed by National Polychemicals, Inc., Wilmington, Mass. Designated Kempore R-125, the chemical is said to be non-toxic, safe to handle, and not to support combustion. According to

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SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
MID-WEST: National Rubber Machinery Company, 5875 N. Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

The Plastiscope

the company, it produces odorless, non-staining, non-discoloring closed-cell sponge of low density and with fine and uniform cell structure.

The material is now in commercial production at the firm's 60-acre plant site in Wilmington. A new plant is under construction for additional Kempore capacity and for the production of other organic chemicals under development by the firm.

Mix your own and save

Molders can now mix their own impact phenolic material at savings from 5¢ to 10¢ per lb., according to an announcement by Barrett Div., Allied Chemical & Dye Corp. Barrett, which supplies the liquid phenolic resin, has developed formulas and mixing procedures which it claims can be adopted profitably by molders.

Easier-to-seal saran

Saran specially processed and treated to make it heat-sealable on conventional packaging machinery has been introduced by Printon Corp., 304 E. 23rd St., New York, N. Y. Designated Saran-O-Seal, the material is claimed to process as fast and economically as cellophane.

Until recently, users of Saran Wrap had to have special electronic machines for sealing and to employ additional labor for packaging with saran, but various processors have recently learned how to treat it for use on conventional machines.

Saran-O-Seal is available in all widths and thicknesses of Saran Wrap, from 50 to 200 gage.

Cryovac in rolls for shrink packaging

Positive-sealing shrinkable Cryovac film for wrapping meats, cheese, and poultry has been developed and is now being introduced to the market by The Cryovac Co., Div. of W. R. Grace & Co., Cambridge, Mass. It comes in roll form in contrast to the shrinkable bag type which has become so widely used as a wrapper for turkeys and other poultry.

The material in the new film is basically the same as that used in Cryovac bags and provides a good moisture-vapor and oxygen barrier. Its shrinkable qualities enable the film to provide a skin-tight fit to the product.

The roll type of shrinkable film will make possible a speedier handling of meats and cheese than the bag type operation. It is now being used on hand-wrapping applications but is claimed to be usable on many semi-automatic and automatic packaging machines presently in use.

Boron compounds

Three amine boranes—dimethylamine-borane, trimethylamine-borane, and pyridine-borane—are now available from Callery Chemical Co., Callery, Pa., in research quantities. Manufacture of related chemicals for bulk uses is expected to assure future availability at moderate cost.

These compounds are polymerization catalysts for styrene and inhibitors for acrylates and vinyl compounds. They act as selective reducing agents in non-aqueous solvents. In addition, applications as anti-oxidants and stabilizing agents have been suggested as promising possibilities.

Vacuum formed shower door

Shower doors continue to be a growing market for plastics. Folding-type doors were described in Modern Plastics 35, 144 (September 1957). Now comes word that a popular-priced sliding door unit for home showers is vacuum formed from translucent 0.60-in. Campco rubber-modified styrene sheet material S-320. The sliding shower door assembly is marketed by Standard Mfg. Co., Chicago, Ill.

The new unit fits all recessed wall-to-wall bathtubs up to 5 ft. in length, and may be installed by do-it-yourself homemakers in a matter of minutes, according to Campco, a division of Chicago Molded Products Corp., producer of the sheet.

Advantages claimed for the door are light weight, shatterproofness, and easy action.

Polyethylene matting

Extruded polyethylene ribbed matting, expected to replace conventional rubber matting in many applications, has been introduced by Borden Co.'s Chemical Division. Designated Perma-Mat, the semi-translucent plastic is available in rolls 30 in. wide and 6, 50, and 100 ft. long. The matting is produced by Lawrence Processing Co., N. Andover, Mass., a wholly owned subsidiary.

Applications include hallway runners, stair runners, drainboard coverings, shelf mats, place mats, automobile floor mats, rainy-day rug protectors, etc.

Wholesale prices are $1, $7, and $14 for the 6-, 50-, and 100-ft. lengths, respectively. They are expected to retail at about $2.15, $15, and $30, respectively.

Foam for electronic packaging

Dayton Rubber Co., Dayton, Ohio, has announced that it is ready to make available to electronics equipment manufacturers the liquid components, technical advice, and foaming equipment required to comply with a United States Navy authorization providing for the use of resilient, rigid, and semi-rigid urethane foams as a packaging material for safer shipments of fragile electronic parts and instruments.

The Navy authorization permits electronics equipment makers to use Dayton's Poly-Kool-foam materials in a variety of ways, including foaming-in-place, prefoamed, prefoamed around models, or by molding in forms.

Vinyl foam for heat sealing

An open-cell vinyl foam—No. 738—said to be especially suited for electronic heat sealing to cloth or vinyl sheeting, has been announced by Foam King, Inc., 1816 Boston Rd., New York, N. Y. Properties claimed for the material are low plasticizer content and low lubrication to prevent plate-out on dies; firm body and

good resilience; fine, uniform cell structure; fire retardancy; and freedom from odor.

Foam King No. 738 is available in a variety of heat- and light-stabilized pastel colors in densities from 6½ lb./cu. ft. up and in thicknesses from 1/16 in. up.

Release liner

Manufacturers and packagers of very sticky materials are offered a new type of release paper by Fasson Products, Painesville, Ohio. The liner is said to resist adhesion even by extra high tack materials such as synthetic and natural rubbers, asphalts and tars, gums, pressure-sensitive adhesives, etc.

The material can be used in sheets for wrapping or separating sticky materials or can be incorporated in the manufacture of paper boxes, drums, and other containers. Either one or both sides of the material may be release coated.

Polyethylene pipe and fittings

A line of polyethylene pipe and fittings for the transmission of drinking water, beverages, syrups, pulps, acids, alkalies, and chemical solutions is now available from Acme Rubber Mfg. Co., Div. of Acme-Hamilton Mfg. Corp., Trenton, N. J.

Designated Acme N. T. Flex Brand, the pipe is made from virgin polyethylene, compounded with non-toxic ingredients. It is available in a wide range of nominal pipe sizes from ½ to 3 in. and for pressure ratings from 55 to 100 p.s.i. Fittings include regular and reducing-type insert tees, elbows, and couplings; adapters; combination reducing elbows and tees; and threaded tees, elbows, and couplings.

Plasticizer for high-humidity service

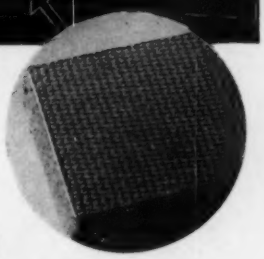
Polymeric plasticizer Paraplex G-54 for vinyl chloride polymers, recently introduced by Rohm & Haas Co., Philadelphia, Pa., is said to be of particular interest for applications where freedom from exudation on exposure to high humidity is essential. The company claims that vinyl compounds plasticized with Paraplex G-54 have very good resistance to oils,

2 new reinforcing materials—

Troytuf DACRON* and ORLON*

now open limitless opportunities in plastic product applications!

EXAMPLE: Troytuf Orlon-reinforced IPM panels serve as effective weather-shields on Bremerton Elementary School, Bremerton, Wash. The school is one of eight public buildings in the area to use this panel, made by Industrial Plastics Manufacturing Co., Seattle, Wash.



Your Requirements and Your Imagination Set the Only Real Limits on Troytuf's Uses

What's Troytuf like? Troytuf Dacron and Orlon Blankets are extra-tough, lightweight reinforcing materials, specially suited to molding and laminating. They differ from most reinforcing media in that the fibres are tightly interlocked into easily-handled blanket form by a novel needle-punching operation.

Important: In some applications it is even possible to maintain most of the properties and advantages of Troytuf blankets, while using them only as veils and/or overlays.

TROYTUF's Big Advantages

- Provides higher abrasion resistance than glass
- Offers better resistance to corrosive mineral acids
- Has excellent electrical properties—even when wet
- Has exceptional weatherability (Troytuf Orlon)
- Is safer material for food, drug-handling machinery and containers
- Yields smoother, better-looking finish
- Has low moisture absorption
- Permits more uniform fiber loading—no resin-rich corners
- Provides better formability after curing
- Eliminates pre-forming

Why not write us *your* laminating problem. We'll be happy to send you full details and samples for experimental molding. *Troy Blanket Mills, 200 Madison Avenue, New York 16, N. Y.*

REINFORCING **Troytuf** BLANKETS

*DuPont trademark

gasoline, soaps, and detergents and are well suited for use in contact with polystyrene (both modified and unmodified), with rubber and rubber base materials, and with nitrocellulose enamels and alkyd-type finishes.

Applications include refrigerator gaskets, electrical and surgical tapes, babywear film, hospital sheeting, high-temperature electrical insulation, upholstery sheeting and coated fabric, and wall covering.

Ten years for Argus

An anniversary commemorating its 10th year in business is being celebrated this month by Argus Chemical Corp., Brooklyn, N. Y. Argus is a pioneer developer of barium-cadmium stabilizers which are particularly notable for heat and light stabilization in vinyl chloride resins. They are marketed under the tradename Mark Stabilizers.

Two new plasticizers, Drapex 3.2 and 4.2, which are monomeric epoxies and offer a combination of low-temperature resistance and flexibility, have recently been added.

William Leistner, who founded the company with Miss Oga Knouepke, is president of the organization.

High-absorbent paper for laminates

A saturating base paper for electronic laminates and other applications requiring high absorbent capacity has been developed by Knowlton Bros., Watertown, N. Y. Designated Grade #101, the low-density paper is claimed to be extremely uniform in weight and thickness. Its high alpha cellulose content gives it a good absorbency rating (in Klemm capillarity test) of $^{15}/_{16}$- to 1¼-in. water rise in 1 minute.

Beta gages insure uniform consistency of the paper during its manufacture, controlling weight to within plus or minus 4% throughout. Precision tolerance control is another essential quality for such typical applications as printed circuits and various types of insulation, where laminates are composed of sheets of Grade #101 impregnated with phenolic resin.

The paper is available in colors, including black and white, in rolls up to maximum widths of 72 to 80 inches. Absorbent capacity, weight, and thickness can be controlled to meet customer specifications.

Tile accessories

Low-priced Windsor wall tile adhesive has been introduced by The Miraplas Tile Co., 980 Parsons Ave., Columbus, Ohio. A pure compound, the material is said to spread easily, not to string, and to have good holding power over long periods. The company states that Windsor adhesives conform to all requirements of Commercial Standard CS-168-50 tests, making it acceptable for use in VA and FHS installations.

Windsor tile cleaner and sealer are also offered.

Fluorocarbons

For wire and cable. Teflon electrical tubing in the range from AWG #30 through AWG #0 is now available from Dixon Corp., Bristol, R. I., in both natural and colors. All sizes are offered in thin, heavy, and non-standard wall thicknesses, ranging from 0.010 through 0.026 inch. Properties claimed for the tubing include 1) service at from −40 to +500° F.; 2) no shrink-back from soldering iron contact; 3) good dielectric properties over a wide range of frequencies and temperatures; 4) complete chemical inertness to all chemicals and solvents, except molten alkali metals and fluorine at elevated temperatures and pressures; 5) zero moisture absorption; and 6) good aging resistance, extreme weather resistance, and absence of effects due to aging.

The company also announces a line of Teflon skived tape for wire and wrapped insulation. It is said to have dielectric strength of 1000 to 2000 v./mil; dielectric constant of 2.0; and a power factor of less than 0.0003 through the entire frequency range. The skived tape is available in widths from $^{3}/_{16}$ to ¾ in. and in thicknesses from 0.002 in. up.

Kel-F insulated wire. High-temperature hook-up wire insulated with Kel-F-500 is now being manufactured by National Electronic Plastics, Inc., Matawan, N. J., in the popular stranded AWG #18, #20, #22, #24, and #26. It can also be supplied on special order in all standard AWG sizes, both stranded and solid. The material is available in 14 standard Signal Corps approved colors. According to the company, the wire exceeds military specification MIL-W-12349.

Epoxies

Honeywell to sell epoxies. Minneapolis-Honeywell Regulator Co. has started full-scale production of epoxy casting and potting compounds, designed especially for use in the electronics industry. A new epoxy hardener is an important key in the development of these resins which the firm has been using to satisfy the encapsulating requirements of the company's Aeronautical Div. for some time.

Special features of the firm's epoxy compounds include low thermal coefficient of expansion (approaching that of metal itself), good electrical insulation properties, along with high flexural strength (14,000 p.s.i.).

The company will offer four epoxy casting compounds, including: 1) a general-purpose, room-temperature curing compound which will harden in 20 min. to 2 hr., for use in situations where electronics parts cannot stand high-temperature cures; 2) a high-temperature-resistant compound with low coefficient of thermal expansion and extremely low cure shrinkage; 3) a hermetic-sealing compound which is cured at elevated temperatures. This compound is especially effective where delicate parts must be protected against moisture and

gas leakage; and 4) a free-machining epoxy compound that has good dimensional stability and high heat resistance. It is used when finished parts require tooling.

Radiation barrier. A lead-filled epoxy formulation, Maraset 341, has been addded to its line of epoxy resins by Marblette Corp., Long Island City, N Y. The new resin was developed for industrial applications that require a high-density casting compound. It is suggested by the company as a barrier against radiation and for use in constructing shields for nuclear installations and containers used to ship radioactive materials.

Maraset 341 can be furnished in various lead loadings up to 95% by weight. Properties include dimensional stability and negligible shrinkage. It is said to pour easily for casting, even in intricate shapes, with faithful reproduction of detail. No finishing is required.

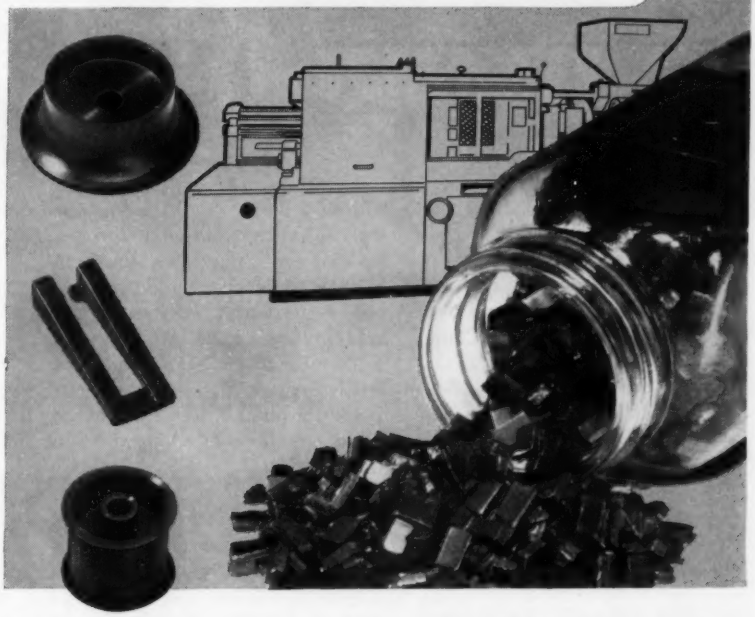
New epoxy division. To help the customer by advancing epoxy resin technology, the Epoxy Resin Formulators Div. has been organized in The Society of the Plastics Industry, Inc. It will cover the electrical, tooling, and adhesives fields.

In cooperation with other groups, the division will develop specifications, chemical and physical test procedures, performance standards, and testing programs covering epoxy compounds for both industrial and consumer applications. Also, the division will prepare statistics and other information of value to its members and industry in general.

Colorants. A line of paste colors for liquid epoxy resins is now available from Ferro Corp.'s Color Div., Cleveland, Ohio. In a medium of 100% epoxy resin, the pastes are said to provide good color dispersion and high color stability.

Because of inherent stability, inorganic pigments composed of cadmium, selenium, cobalt, titania, copper, chrome, and other raw materials are used wherever possible. Using both inorganic and organic colors, and black and

NYLATRON® GS MOLDING POWDERS



Unique properties of NYLATRON® GS Nylon raise performance of molded parts

When performance specifications demand the very best, parts molded from Nylatron GS will be selected every time. Nylatron GS Powders are a combination of nylon and a dry lubricant — molybdenum disulphide*, now available for high volume, low cost molding of parts. Nylatron GS material is also furnished in standard stock shapes. The increasing use of Nylatron GS parts is proving the value of these outstanding characteristics:

Exceptional Dimensional Stability

Low coefficient of linear expansion and minimum distortion after molding, provides accurate, close tolerance molding.

Low Surface Friction

When wear parts must run dry, Nylatron GS parts operate without lubrication.

High Wear and Abrasion Resistance

Part surfaces resist abrasion and demonstrate long wear in contact with metals.

High Heat Distortion Temperature

Nylatron GS parts provide higher modulus of elasticity and higher heat distortion temperatures than standard nylon 101.

Chemical Resistance

Nylatron GS parts are unaffected by alkalis and most solvents including hydrocarbons.

Write today for detailed information on Nylatron GS and name of your nearest Nylatron GS molder.

**Patents applied for*

POLYPENCO

NATIONAL POLYMER PRODUCTS, INC.

A Subsidiary of The Polymer Corporation, Reading, Pennsylvania
Export: Polypenco, Inc., Reading, Penna., U.S.A.

The Plastiscope

white, all specifications for color shade, stability, and dispersion can be met. Special colors for volume applications can be matched and supplied by the company.

Hard face. A blue epoxy resin compound, designated Sonite SC-2, has been developed by Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City, N. J., for use in hand lamination systems where surface hardness and resistance to abrasion are essential.

The compound is said to have sufficient thixotropy for application as a heavy brush coat, without sagging, on a vertical surface. Used with a laminating resin and glass cloth, Sonite SC-2 is claimed to produce hard-surfaced dies of light weight, high strength, and good dimensional stability. It also may be used alone as a surface coat for tanks and barrels, and as a bonding agent with good adhesion and chemical resistance and stability.

Adhesive for vinyl film. A solventless vinyl adhesive, Epocast 126, specifically developed for "welding" vinyl compounds, has been announced by Furane Plastics, Inc., 4516 Brazil St., Los Angeles, Calif. The company claims that the welding features of the material and the lack of solvent may increase the use of decorative vinyls in automotive and aircraft metal interiors. Epocast 126 is stated to bond vinyl sheets to steel, aluminum, masonite, wood, and other surfaces and that rigid as well as most semi-rigid sheets can now be bonded to concrete and metal.

Expansion

Barrett Div., Allied Chemical & Dye Corp., announces the completion of its Plaskon polyester plant in Toledo, Ohio, which it claims will be the largest polyester producing operation in the country. The new facilities will more than double Barrett's production capacity. The polyesters produced in Toledo will include adipic type polyesters for use with isocyanate in production of urethane foam as well as the conventional styrene-maleic type polyester used in reinforced plastics. Additions include the latest equipment for raw materials handling, increased bulk storage facilities, and new kettles—in effect, an all-new polyester plant. Truck loads of the resin can now be shipped on a day's notice.

Wilson & Geo. Meyer & Co. and **Wilson Meyer Co.,** Pacific Coast sales representatives for **Eastman Chemical Products, Inc.,** subsidiary of **Eastman Kodak Co.,** is building a new office, warehouse, and tank farm at 2060 Garfield Ave., Los Angeles, Calif., at an estimated cost of $500,000. The new facilities will provide better and more complete service for Eastman's customers throughout southern California.

Lunn Laminates, Inc. has acquired its fourth plant on Railroad Ave., Huntington Station, N. Y., to accommodate a large order for 36-ft. reinforced plastics Navy landing crafts, 68 of which are scheduled for production now. The plant, occupying 32,000 sq. ft., will also house the executive offices formerly located on Oakwood Rd.

Smaller reinforced plastics parts will continue to be manufactured at the previous address, as well as the new orders coming in, representing a backlog of over $1 million.

Haveg Industries, Inc., Wilmington, Del., has acquired **Reinhold Engineering & Plastics Co., Inc.,** Norwalk, Calif. Reinhold is a fabricator of plastics for corrosion control equipment and the aircraft missile industry. The company now has 220 employees and has had experience in handling polyesters, epoxies, heat-resistant phenolics, melamines, silicones, alkyds, and diallyl phthalate with reinforcing materials. Facilities include molding presses ranging from 100 to 750 tons.

Reinhold's general custom molding business will be continued as before.

The Danielson Mfg. Co., Danielson, Conn., subsidiary of **Nicholson File Co.,** has completed a new building for its Plastics Extrusion Dept. and machine shop. One room of the new structure will have on display working models of the Battenfeld injection molding machines which are being distributed in this country by **Molding Systems, Inc.,** a subsidiary of Danielson.

Kleentest Products Co., 234 N. Broadway, Milwaukee, Wis., announces the formation of **Kleenfoam Div.** to engage in custom cutting, fabricating, and packaging of urethane foam in many different forms, cell sizes, densities, and qualities. The company states that it is equipped to handle a wide range of assignments in the fields of industrial contract work and new product development.

Morningstar, Nicol, Inc., 630 W. 51st St., New York, N. Y., is negotiating for the acquisition of **Federal Adhesives Corp.,** New York, N. Y. Operations of Federal will be coordinated with **Paisley Products, Inc.,** Morningstar's adhesive-producing subsidiary. It is contemplated that a separate division will be maintained. The Federal name and all its products will be continued, and key personnel will become members of the Morningstar organization.

Three affiliates operated by Federal—**Adex Mfg. Co., Federal Latex Corp.,** and **Federal Chemicals Corp.**—are included in this transaction.

Canadian Titanium Pigments, Ltd., a subsidiary of **National Lead Co.,** announces that it has started full production in Canada's first titanium pigment plant at Varennes, Que. Most of the titanium pigments consumed in Canada, mainly by the plastics, paper, rubber,

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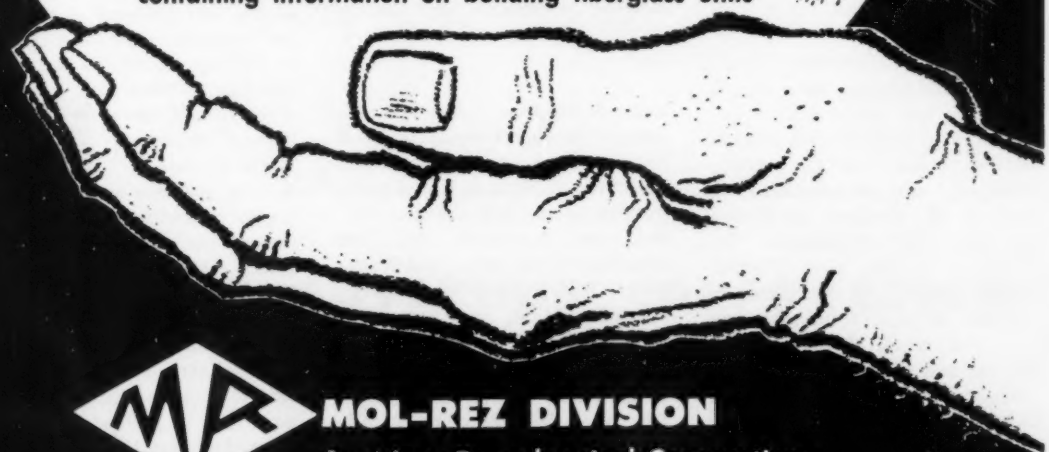
REINFORCED PLASTICS BULLETIN NO. 23
containing information on building fiberglass units



MOL-REZ DIVISION
American Petrochemical Corporation
Minneapolis 18, Minnesota

The Plastiscope

and paint industries, have for many years been imported from the United States. The company states that the new 76-acre plant will make Canada virtually self-sufficient in titanium pigments.

Pneumatic Scale Corp., Ltd., Quincy, Mass., manufacturer of automatic equipment for the packaging industry, has acquired **Carbert Mfg. Co., Inc.,** Waltham, Mass., designer and builder of machines for filling and sealing plastic containers, including tubes, bottles, and extruded films. Carbert will operate as a wholly owned subsidiary of Pneumatic and will continue under the same management with its founder, **Robert W. Saumsiegle,** as president and general manager.

Plastic Materials, Inc., Hicksville, N. Y., has opened a plant in Chicago, Ill., and announces plans for new regional operations in other territories to establish nationwide coverage with full manufacturing and processing facilities in each plant. **Chris J. Runfola,** vice president, will head the Chicago plant. PMI is a manufacturer of cellulose acetate and ethyl cellulose and a compounder of polymethylstyrene, acrylic, polyethylene, and polystyrene.

Dresser Manufacturing Div., Dresser Industries, Inc., Bradford, Pa., has established a department to develop and market plastics products for the joining, repairing, and maintenance of pipe. **S. B. Hodges,** marketing manager, will coordinate the activities of the new Plastics Products Dept. The company is a supplier of pipe, couplings, fittings, and repair devices to the gas, oil, and other industries.

Epoxy resin compounds called Epi-Seal, manufactured by **Bonded Products, Inc.** for Dresser, have been introduced for pipe repair applications as the first step in Dresser's use of plastics for pipe repair. Plans are under study to offer a complete field application service which will specialize in the repair and rehabilitation of underground piping.

H. Z. Hight, formerly regular products sales manager of Dresser since 1945, was elected president of Bonded Products, Inc. For the past three years he has coordinated all phases of planning for plastics research and will continue as a consultant on the marketing of plastics and other Dresser products.

Consolidated Plastics, Div. of Consolidated Molded Products Corp., has opened a new 16,000-sq. ft. plant at 489 Conklin Ave., Binghamton, N. Y. Equipment for injection molding, finishing, decorating, and assembly has been installed and future plans contemplate the addition of new equipment for compression and transfer molding and other forms of processing. **George Puderbaugh** is plant manager.

Plastics Masters, Inc., Chicago, Ill., has purchased the molds and inventory of the Mallo-Tone line of dinnerware and picnicware, formerly manufactured by P. R. Mallory Plastics, Inc. Plastics Masters' tradename of Superlon Products will be used for the new line.

Tidland Machine Co., manufacturer of paper mill equipment and leaf- and lug-type pneumatic shafts for winding and unwinding plastics, paper, pulp, textiles, rubber, and aluminum foil, has consolidated its Camas and Washougal, Wash., plants into a single operation at its new factory at 2363 S.E. Eighth Ave., Camas.

E Z Paintr Corp., Milwaukee, Wis., manufacturer of paint rollers and allied items, has purchased **Keno Plastics Processing, Inc.,** Kenosha, Wis. The plastic plant will operate as a division under the name of **E Z Plastic Processing, Inc.** Keno has been making plastic decoys and is tooling to produce sponge plastic paint rollers and other molded plastic products.

Officers appointed are: **Vern Touchett,** president of the parent company, named board chairman of the new division; **Fred Sohr,** president; **Robert L. Touchett,** vice president; **James J. Quinn,** treasurer; and **Herbert L. Stern, Jr.,** secretary.

Amplex Mfg. Co., Philadelphia, Pa., plastics fabricator, has opened a midwestern plant in St. Louis, Mo., to warehouse Amplex corrugated Plexiglas, flat sheet Plexiglas, and formed plastic sign faces and to produce flat cut-out letters and fabricated plastic letters. The company plans to add equipment later to manufacture formed plastic letters.

Another good sign that distribution sources for methacrylate sheets are growing, is the company announcement of the establishment of a network of distributors from coast to coast.

Curtiss-Wright Corp. and **General Aniline & Film Corp.** have announced negotiations to explore the desirability of a joint venture for the production and marketing of chemicals for synthetic materials, including plastics.

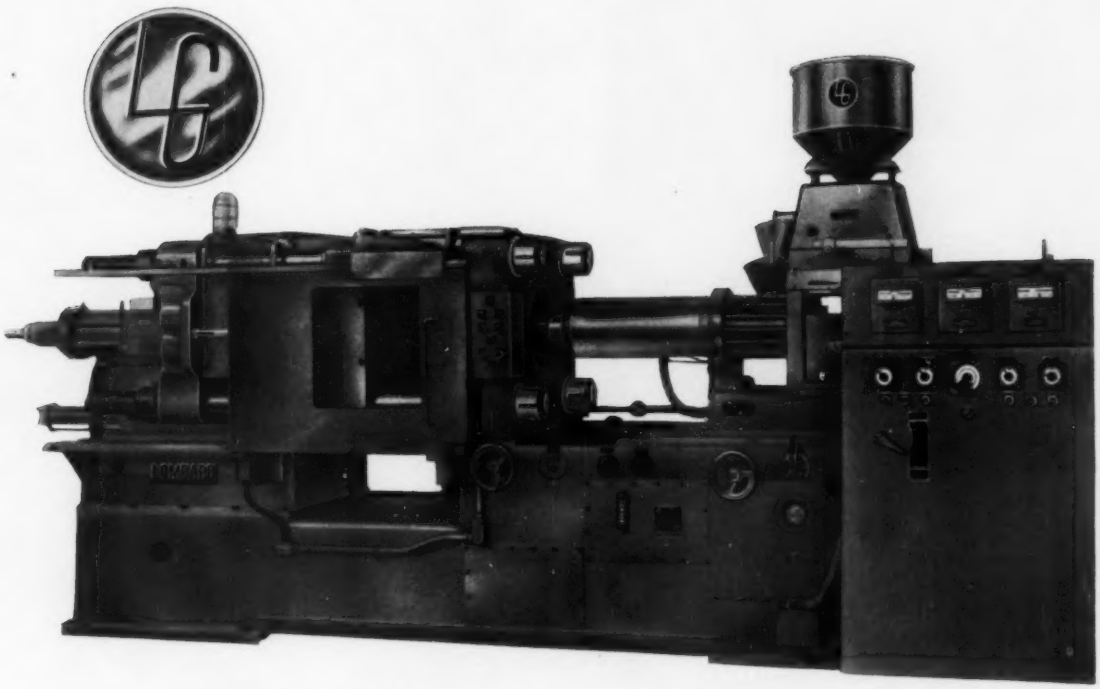
Deceased

Madison Melville Makeever, one of the real pioneers of the plastics industry, died on October 1 at the age of 88. In the 1920's, together with his wife, Viola, he formed Makalot Corp. to manufacture specialty phenolic molding compounds. In 1939, Makalot Corp. received a MODERN PLASTICS Annual Competition Award for supplying the material for a 14-lb. dry-cleaning agitator—one of the largest phenolic pieces molded up to that time. Makalot Corp. was eventually taken over by Interlake Chemical Corp.

M. Makeever

Mr. Makeever was one of the

(*To page* 300)



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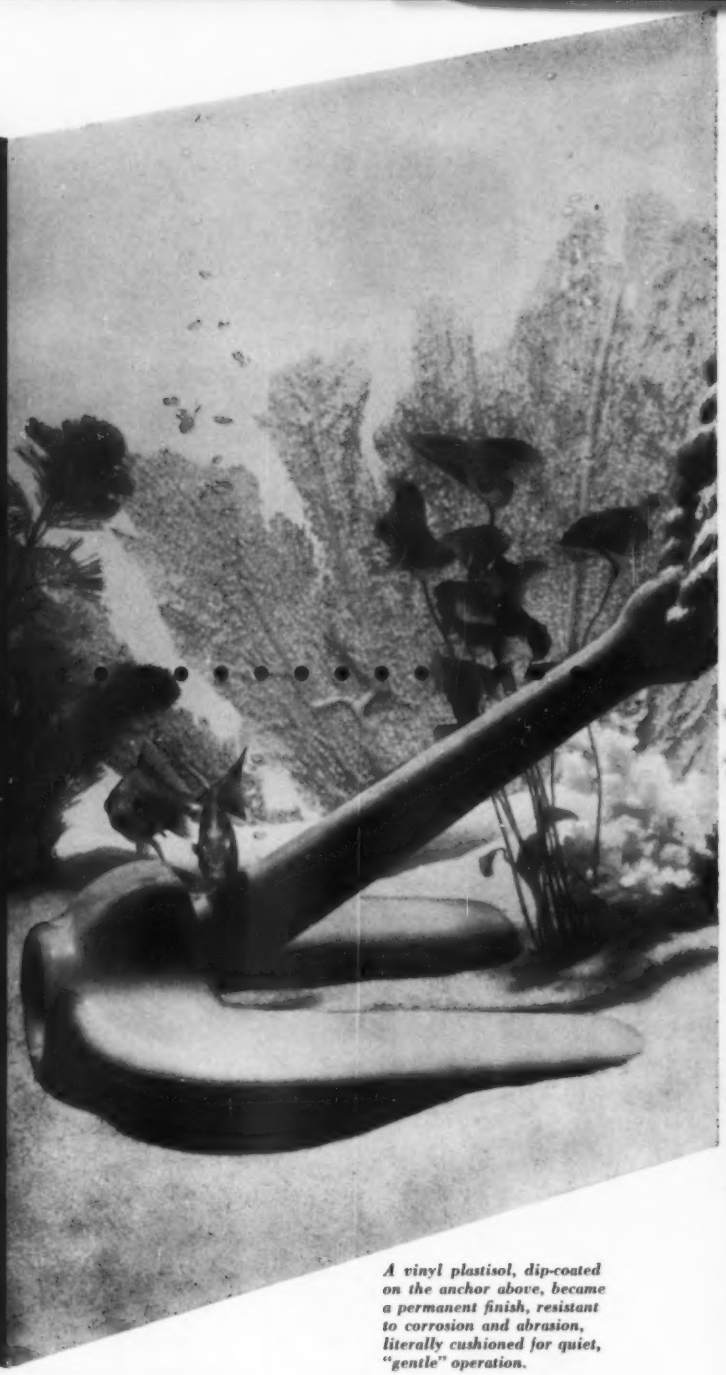
The broad Monsanto series of Vinyl resins and compounds



A vinyl plastisol, dip-coated on the anchor above, became a permanent finish, resistant to corrosion and abrasion, literally cushioned for quiet, "gentle" operation.

From a specially developed Monsanto vinyl paste resin, *Opalon 410*, come the finest vinyl plastisols. And from these colloidal dispersions of vinyl resin in plasticizers, come permanent and resilient finishes for metals, coated fabrics and paper for quality luggage, flooring and upholstery . . . slush-molded rain boots and dolls' heads . . . cast packaging films . . . foams for insulation and sound-proofing . . . caulking compounds and sealants.

Monsanto has developed Opalon vinyl resins and compounds to meet many requirements. There are Opalon resins and compounds for extruded and molded vinyl products of almost every type, including wire and cable insulation and jacketing, flooring, phonograph records.

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A vinyl plastisol, rotationally molded, produced the one-piece float above. It won't sink. It won't rot. Its brilliant colors will remain true forever!

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early members of The Society of the Plastics Industry, Inc. and served as an officer with that organization. He was also one of the early members of the Plastics Materials Manufacturers Association.

Frazier Groff, assistant director in **Bakelite Co.'s** development facility at Bound Brook, N. J., died on September 11 at the age of 62. His career included development work dealing with polystyrene, vinyl, and other materials.

Ralph Fulton, with the company 27 years and project leader in **Bakelite Co.'s** Development Labs at Bound Brook, N. J., died on August 27 at the age of 52. He was active in the field of infrared spectroscopy.

Meetings

Plastics groups

November 11: Society of Plastics Engineers, Inc., Regional Technical Conference, Ambassador Hotel, Los Angeles, Calif. Subject: "Plastics for Air-Borne Electronics."

December 10-11: The Society of the Plastics Industry, Inc., Eighth S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York.

January 28-31: Society of Plastics Engineers, Inc., Fourteenth Annual Technical Conference, Sheraton-Cadillac Hotel, Detroit, Mich. Subject: "Progress Through Plastics Engineering."

February 4-6: The Society of the Plastics Industry, Inc., Thirteenth Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

March 26-29: The Society of the Plastics Industry, Inc., Pacific Coast Section, Fifteenth Annual Conference, Palm Springs, Calif.

Other meetings

November 7-9: The Society of Rheology, Annual Meeting, Textile Research Institute, Princeton, N. J.

November 20-21: The Chemical Market Research Association, Joint Meeting with Chemical Commercial Development Association, Shamrock Hotel, Houston, Texas.

November 20-22: American Society for Testing Materials, Meeting of Committee D-20 on Plastics, Cavalier Hotel, Virginia Beach, Va.

December 1-6: The American Society of Mechanical Engineers, Annual Meeting, Statler and McAlpin Hotels, New York, N. Y. (Rubber and Plastics Sessions, December 4 and 5).

December 2-6: Twenty-sixth Exposition of Chemical Industries, Coliseum, New York, N. Y.

December 4-5: Building Research Institute, Conference on "Adhesives and Sealants in Building," Shoreham Hotel, Washington, D. C.

January 16-23: National Housewares Manufacturers Association, Twenty-eighth National Housewares Exhibit, Navy Pier and Drill Hall, Chicago, Ill.

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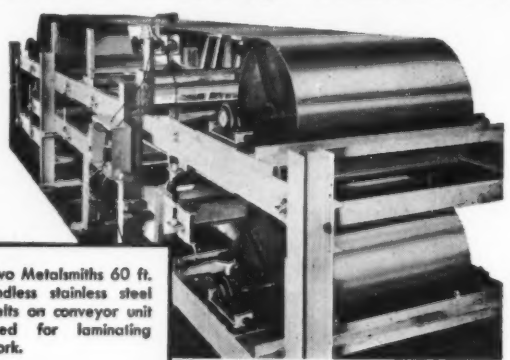
ENDLESS STAINLESS STEEL BELTS
Speed up Cooling — Setting — Conditioning
of Sheets—film—coatings—laminated work



Two Metalsmiths 60 ft. endless stainless steel belts on conveyor unit used for laminating work.

Automatic Contact Gloss
Polished stainless steel belt provides high gloss as materials move through cooling and conditioning.

Investigate continuous belt-processing for increased production and lower costs. One-piece, polished or unpolished, in any length and extra-wide sizes. Stainless steel (18-8) provides dense, corrosion-free surface. Width and camber controlled. Consult our engineers. Metalsmiths, 558 White St., Orange, N. J.

METALSMITHS STAINLESS STEEL
ENDLESS CONVEYOR BELTS

Companies . . . People

B. F. Goodrich Chemical Co.: Charles B. Cooper, with the company 27 years and presently plant manager of the Akron chemical plant, appointed plant manager of the new Henry (Ill.) General Chemicals plant which is scheduled for completion in early 1958. **Edwin W. Harrington,** a veteran of 20 years with the firm and director of rubber and rubber chemicals development at BFG's Development Center at Avon Lake, Ohio, will succeed Mr. Cooper in the Akron post as plant manager.

American Cyanamid Co.—Formica Corp., Product Engineering Dept.: George E. Power, director of research, transferred to American Cyanamid's Research Div. at Stamford, Conn., to supervise research on behalf of Formica. **Alex Malashevitz,** named director of research and development, will be in charge of resin and product development and resin manufacture. **Dr. Stephen Grozos,** formerly engaged in basic research on polymer chemistry for the parent company, will move to Cincinnati as manager of resin development. **William O. Hess,** formerly a project engineer, now manager of product development, will be responsible for all Formica general laboratory facilities. **Kenneth Arata,** manager of process engineering, will also assume responsibility for all testing operations.

The Dayton Rubber Co.: A. L. Freedlander, president since 1936, elected chairman of the board and will continue as a full-time officer directing company expansion, development of new products, and acquisition of subsidiary business organizations. **Clowes M. Christie,** president of **American Latex Products Corp.** and **Pacific Polymers** (subsidiaries), succeeds Mr. Freedlander as president of the parent company. **P. J. Mayle,** vice president and assistant secretary, elected to the newly created office of executive vice president.

American Latex Products Corp.: T. Patrick Dougan appointed executive vice president and general manager; **Glen E. Mallory** named treasurer-vice president.

Borden Co.—Chemical Div.: Mario J. Cardone, formerly with Wyandotte Chemicals Corp., now head of the analytical research group at the Philadelphia Research Laboratory. A specialist in absorption spectroscopy, Mr. Cardone will be responsible for developing new methods for analyzing and processing synthetic resins and plastics. **L. George Hoth,** previously assistant sales manager for adhesives, promoted to manager of the newly created merchandising section of the Consumer Products Dept. He will be assisted by **Martin F. Cody.** The new section was established to correlate merchandising and sales promotional activities for adhesives, vinyl garden hose and sprinklers, and nitrogen ureaform fertilizer.

Union Carbide Corp.—Bakelite Co.: R. C. Schroeder, with the company since 1947 and formerly a technical representative with the Calendering Materials Div. in the Clifton, N. J., district sales office, appointed assistant manager of the division and will assist **C. D. Schuman,** manager. **F. W. Wurtzell,** with the firm since 1942 and previously technical representative in the Chicago district office, named Central Zone manager of the Extrusion Materials Div. at Chicago. **Richard E. Graebert,** with Union Carbide since 1945 and formerly a production engineer in the Vinyl-Polyethylene Dept., promoted to assistant department head of the Formaldehyde Dept. at Bound Brook, N. J.

The Goodyear Tire & Rubber Co.—Films and Flooring Div.: A. F. Thomas, with the company since 1942 and formerly eastern division regional manager, appointed to newly created post of division field sales manager. **J. D. Long,** with the firm since 1948 and previously western regional manager, named manager of flooring sales to succeed **H. M. Evans** who has been assigned to special projects in conjunction with the Flooring Dept. The two division regional sales posts have been eliminated and duties previously assigned to the regional managers have been taken over by the field sales manager.

Monsanto Chemical Co.—Plastics Div.: William S. Sevier, formerly superintendent of production coordination at the Texas City, Texas, plant, appointed to the newly created post of manager of materials distribution and transportation at Springfield, Mass. **George F. Stevenson** has joined the development group in the Engineering Dept. **Warren L. Johnson** now with the Sales Dept. **Dr. Ahmad Kianpour,** formerly with the Research Association at the University of Colorado, has joined the Research Dept. at Texas City, Texas.

Organic Chemicals Div.: Forrest M. Luckett, formerly Chicago district sales manager, appointed to newly created position of central regional sales manager in Chicago. **Ernest S. Robson** now New York district sales manager and **Anthony J. A. Bryan** assistant district sales manager. **H. James Lawler** appointed assistant director of sales of plasticizers, resin materials, and paper chemicals at St. Louis.

Summit Industries, Inc., 2104 W. Rosecrans Ave., Gardena, Calif., has been formed to specialize in the manufacture of reinforced plastics products. The company will start operations in a new 10,000-sq. ft. building. Initial equipment consists of three ovens, electrically heated for temperatures up to 600° F., the largest of which can accommodate molds up to 7 ft. high by 12 ft. wide by 14 ft. long; and a 100- and a 50-ton press, soon to be augmented with a battery of additional presses now under construction.

The firm will be engaged in wet lay-up of solid laminates and sandwich structures and press molding

A. S. Greenberg

E. C. Mireau

of preform, premix, mat or cloth moldings, and molding compounds using polyesters, phenolic, silicone, and epoxy resins.

Albert S. Greenberg, formerly chairman of the board and executive vice president of Zenith Plastics Co., is president; **E. Chris Mireau,** formerly vice president of manufacturing of Zenith, is vice president.

Seiberling Rubber Co.: A. L. McMullen elected vice president in charge of production. **Edwin P. Schrank** replaces Mr. McMullen as manager of production and engineering.

The General Tire & Rubber Co.—John Bolten, Jr. has resigned for reasons of health. He had been a member of the Manufacturing Analysis Dept. since 1956. Mr. Bolten was president of Bolta Products, Inc. until that company merged with General Tire several years ago. At the time of the merger, he became factory manager of the **Bolta Div.**

Textileather Div.: Laurence Scott, with Textileather since 1949, named quality control manager of the newly established Quality Control Dept. The program will afford increased controls over pilot runs of newly developed materials and introduction of the goods into regular production processes.

General Aniline & Film Corp.—Dyestuff and Chemical Div.: Harold G. Shelton, former sales manager of Antara chemicals, recently named director of marketing. **James M. Cloney,** previously manager of the

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Organic Chemicals Dept., succeeds Mr. Shelton as sales manager of Antara chemicals. **John T. Robinson** appointed to the newly created position of director of sales administration.

Interchemical Corp.—Angier Adhesives Div.: Howard Ellerhorst, Jr., with the Finishes Div. for 15 years, appointed vice president and director of sales. **Harrison F. Rowbotham** named vice president in charge of sales promotion.

Becco Chemical Div., Food Machinery & Chemical Corp., has broken ground for a new distributing center in Framingham, Mass., to serve the New England area with Becco's hydrogen peroxide and other peroxygen chemicals. **Philip D. Caine,** New England manager for the company, will be in charge.

Southwestern Plastic Pipe Co., Mineral Wells, Texas: **Charles B. Turner,** formerly sales manager of the Wholesale Div., appointed to director of sales. He will head distribution through two sales divisions—Industrial Div. and Wholesale Div.—with **A. J. Brumbaugh** and **Harry A. Riley, Jr.** as respective sales managers. Both divisions will market five basic types of plastics pipe—Southwestern Kralastic, polyethylene, polyvinyl chloride, butyrate, and Chem-Weld.

The Goodyear Tire & Rubber Co. has moved its Chemical Div. from 292 Madison Ave. to 400 Park Ave., New York 22, N. Y. **Donald E. Neese** is district manager.

Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif., has established an **Adhesive Div.** for the sale of adhesives and sealants. The division will be staffed with application engineers who will provide field service for adhesives users. **Rex D. Brookhart** is marketing manager.

Nashua Corp.: Robert A. Brown, retired from the presidency, elected chairman of the board; **James R. Carter,** formerly general sales manager, succeeds Mr. Brown as president and chief executive officer of the company; **Robert H. Prew,** previously assistant to the president, now executive vice president; **William H. Foster,** formerly sales manager of the Nashua Package Sealing Div., promoted to director of sales.

Shawinigan Resins Corp.: Edmund C. Knapp, formerly research assistant at Pennsylvania State University, now in Research Dept., will conduct fundamental research on polyvinyl acetate copylmer resins. **John R. Danner,** formerly with Koppers Co., Inc., now with the Product Development Dept. **Henry E. Graulich,** previously with American Cyanamid Co., named production supervisor trainee for the Production Dept.

Reichhold Chemicals, Inc.: Four general managers of plants elected vice presidents of the company: **Charles B. Breedlove,** Detroit, Mich.; **Ernest M. Skytta,** Seattle, Wash.; **F. Albert Smiles,** Elizabeth, N. J.; and **Ralph T. Urich,** Ballardvale, Mass.

A & A Reinforced Plastics Co., P.O. Box 27, Long Island City 4, N. Y., recently formed, will formulate and supply resins and fibrous glass to the boating industry. **Allen Lawrence** is president.

Universal Unlimited, Inc., Glen Cove, N. Y., formerly known as Steiner Universal Corp., has acquired the operations previously conducted by **Steiner Plastics Mfg. Co., Inc. Earl G. LeBeau** appointed vice president. **F. L. LaMar,** formerly New England and New York state representative, named sales manager. The company is a supplier of illuminated outdoor signs and fabricates thermoplastic parts for aircraft, electronics, and other industrial uses.

The Point-of-Purchase Advertising Institute: O. H. Stark, vice president of Snyder & Black, New York, N. Y., appointed chairman of the 1957-58 Research, Trade Relations and Speakers Committee; **S. Paul Boochever,** vice president of Gibraltar Corrugated Co., Inc., Jersey City, N. J., accepted the chairmanship of the 1957-58 Public Relations Committee.

American Aerophysics Corp., El Segundo, Calif., has established a new division and manufacturing facilities for the development and fabrication of high-strength, fibrous glass-reinforced plastics laminates for the aircraft and missile industry. The company plans to design and produce such components as jet vanes, rocket exhaust nozzles, aircraft wing and fuselage structures, missile fins and control surfaces, radomes, access doors, and other parts.

Cadillac Plastic & Chemical Co.: New warehouse sales office opened at 2546 Irving Blvd., Dallas, Texas. **Ernest Dourlet,** formerly Southwestern sales representative, promoted to Dallas branch manager.

F. J. Stokes Corp: Louis J. Quitoni has joined the New York field sales staff of the **Press Div.** and will work out of the firm's New York district office at 26 E. 1st St., Mount Vernon, N. Y. Mr. Quitoni has had more than 17 years of experience in plastics technology. Since 1946, he has been

plant superintendent of Bestway Products, Inc., manufacturer of phonograph records and other plastics products; a sales engineer for Watson Stillman Co., manufacturer of plastics molding equipment, where he worked on the design and development of injection molding presses; and production supervisor of Tech-Art Plastics Co., plastics molding firm.

The **International Div.** will handle export sales of blending, mixing, and pilot plant equipment for **Patterson-Kelley Co.**, E. Stroudsburg, Pa., in all foreign countries, except Canada.

Cadillac Products, Inc. has consolidated its two plants at 7000 E. Fifteen Mile Rd., Warren, Mich.

Resistoflex Corp.: Southeastern Plastics Sales Co., Atlanta, Ga., named distributor of Teflon and Kel-F rods, sheets, tubing, and electrical sleeving for the southern states. **Industrial Piping Supply Co.**, Charlotte, N. C., appointed warehousing distributor and will handle Fluoroflex-T hose and hose assemblies in Virginia and the Carolinas.

Houghton Laboratories, Inc.: Russell A. Skiff named assistant sales manager of the West Coast office, 5920 Smiley Dr., Culver City, Calif. He will report to **Lloyd M. Dixon,** West Coast sales manager. Mr. Skiff has been engaged in research and development with epoxy resins and related polymers for the past six years. **John S. Shanly,** formerly chief of plastic chemistry of Electro-Tex Corp., has joined the research staff at Olean, N. Y.

Bjorksten Research Laboratories for Industry, Inc., Madison, Wis., has opened a new unit at 2405 Norfolk St., Houston, Texas, to conduct sponsored industrial research for companies located in the southwest. **Luther L. Yaeger,** vice president, will be in charge.

Hooker Electrochemical Co.: Dr. Michael Worsley and **Richard L. Rogalski** have joined the research staff at Niagara Falls, N. Y. Dr. Worsley has been assigned to the polyesters research group and Mr. Rogalski to the plastics research applications group.

Olin Mathieson Chemical Corp.—Film Div.: The following sales service representatives appointed: **Emil Menes, Jr.,** Middle Atlantic district office, Harrisburg, Pa.; **Edward H. Dayton,** midwestern district office, Chicago Ill.; **Charles A. DeVinne,** New York and New England district office, New York, N. Y.; **Ernest G. Cross, Jr.,** southern district office, Atlanta, Ga.; and **William C. Irving,** western district office, San Francisco, Calif. The division's Customer Service Dept. in New York City has been discontinued, except for the New York-New England converter sales facilities. **Richard M. Wescott** is sales service representative for converter sales, with headquarters at the New York office.

H. B. Fuller Co.: Robert E. Foley, executive vice president, who left the parent company five years ago to establish production operations in the eastern market, returns to St. Paul, Minn., as coordinator of plant operations for the firm's 14 adhesive factories. **H. B. Fuller, Jr.** will continue as president of the Cincinnati affiliate and will also coordinate marketing for all plants. The company manufactures industrial adhesives.

Walter E. Hirtz Plastics Materials, Inc., has moved from 1717 Chetney Dr., W. Covina, Calif., to enlarged quarters at 13916 Garvey Blvd., Baldwin Park, Calif. The company is a dealer and processor of reground or unground thermoplastic.

Seaman Products, 120 W. Providencia Ave., Burbank, Calif., named western representative for Stanpreg pre-impregnated materials by **Standard Insulation Co.,** E. Rutherford, N. J. Seaman will handle sales and

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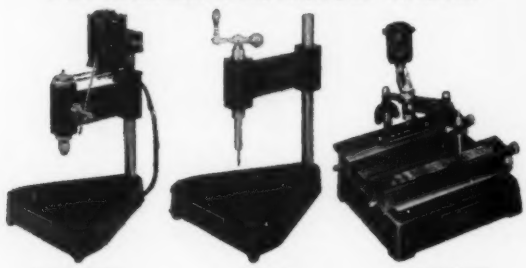

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service for the reinforced plastics, aircraft, and electrical industries. Stanpreg pre-impregnated materials include fibrous glass; synthetics; and cotton and paper pre-impregnated and semi-cured with polyester, epoxy, phenolic, silicone, and DAP resins for specialized structural and electrical applications.

Columbia Pulverizing Corp. has moved its Plastics Div. from Shiller St. to enlarged quarters at 1180 E. Broad St., Elizabeth, N. J., where it will specialize in custom grinding, sorting, and upgrading of all plastics. **Russ Puento**, formerly of American Molding Power Corp., heads the new plant.

Schenck, Brower & Associates, 2263 W. Schantz Ave., Dayton 9, Ohio, named sales representative for southern Ohio by **Dixon Corp.,** Bristol, R. I., and will provide a complete Teflon service, except for dispersion coatings and insulated hook-up wire.

The Garlock Packing Co.: Robert D. Dickey appointed sales representative for the Cleveland branch, succeeding **Donald Hogue,** transferred to Palmyra, N. Y. **Robert W. Scofea** named sales representative for Cuyahoga County, Ohio.

Manton Bros., Ltd., 93 Elizabeth St., Toronto, Ont., appointed exclusive Canadian distributor of plate cylinders, rubber design rollers, and other products manufactured by **Mosstype Corp.,** Waldwick, N. J.

Donald R. Fitzgerald Co., 1005 W. Belmont Ave., Chicago 13, Ill., named Chicago sales representative by **Harry T. Campbell Sons' Corp.,** Baltimore, Md., to handle the sale and distribution of its calcium carbonate extender pigments.

J. Earl Fraser Co., 413 Fisher Bldg., Detroit, Mich., appointed exclusive representative by **Kaye-Tex Mfg. Corp.,** manufacturer of vinyl film and sheeting and supported vinyls, principally used in upholstery, luggage, and for decorative purposes. Fraser will be responsible for all sales in territorial United States and Canada.

Marken Plastic Corp., Los Angeles, Calif., has established a factory branch sales and engineering office at 1014 W. Madison St., Phoenix, Ariz. **Sid Hatch,** president of **Sel-Index Mfg. Corp.,** a plastic experimental and design firm, will head the new office. The office will have a special division to handle irrigation pipe, fittings, and sprinklers, with **Ray Balter,** chief field engineer, in charge. Marken produces all types of extrusion molded plastic items, both custom and standard.

Technical Product Co., 369 Lexington Ave., New York 17, N. Y., named sales representative for greater metropolitan New York and northern New Jersey by **C. H. Whitlock Associates,** Oak Park Mich., and **Automatic Molding Machine Co.,** Los Angeles, Calif. Whitlock manufactures automatic hopper loaders and automatic hopper dryers. Automatic Molding manufactures 25- and 50-ton automatic compression molding machines.

The Carwin Co.: Edward D. Walen, formerly with Pacific Mills, appointed assistant to the president. **R. Bruce Baptie,** previously development superintendent, promoted to the Sales Dept. **Harry E. Smeal,** formerly with The Dow Chemical Co., now development superintendent. The company manufactures isocyanates.

Dr. J. Fred Oesterling, chief of the Chemicals and Plastics Div., Headquarters Research & Development Command, U. S. Army, Natick, Mass., and **Theodore Kapala,** chief of the division's Chemistry Section, have received Certificates of Achievement for their joint presentation of a paper at the first Army Science Conference held recently at the U. S. Military Academy, West Point, N. Y. They also received Special Act of Service Certificates and $125 each for "exceptional contribution to the advancement of the Research and Development Program of the Army."

Dr. Edward Wister Naegele, Jr. has joined **Acheson Dispersed Pigments Co.,** Philadelphia, Pa., as supervisor of basic research. He was formerly associated with Du Pont, where he worked on the synthesis and evaluation of polymers as industrial finishes.

Joseph H. Ehrhardt appointed technical product development engineer **of Marbon Chemical, Div. of Borg-Warner Corp.,** Gary, Ind., responsible for promoting new usages, markets, and increased acceptance of Cycolac polystyrene copolymers. Mr. Ehrhardt was formerly sales manager of DuBois Plastic Products, Inc., Buffalo, N. Y.

Whitney R. Kerchner, formerly special assistant to the president, appointed advertising and sales promotion manager of **Firestone Plastics Co.,** Pottstown, Pa., responsible for the company's line of Exon resins, Velon film, sheeting, and monofilament.

James J. Coleman appointed manager of **Atlas Powder Co.'s** division which markets polyester resins and thermaflow polyester molding compounds. His former affiliations were with Celanese Corp. of America, E. L. Cournand Co., and Marco Chemical Co.

Francis J. Sergeys appointed vice president in charge of development of **W. R. Grace & Co.'s Research and Development Div.** He will be responsible for engineering and commercial activities.

W. Ben Evans, named eastern district manager of the **Plastics Machinery Div. of National Automatic Tool Co., Inc.,** Richmond, Ind., will be in charge of sales and service of Natco plastics injection molding machines in New England, eastern New York, and northern New Jersey.

Roger Williams, Jr., president of **Roger Williams Technical & Economic Services, Inc.,** Princton, N. J., will address the 30th International Congress of the **Société de Chimie Industrielle** at Athens, Greece, on the subject of chemical market research in North and South America.

Paul L. Weller now eastern representative of **Spencer Chemical Co.'s Research and Development Div.,** with offices at 500 Fifth Ave., New York, N. Y. He joined the company in 1953 as manager of market research and became assistant to the vice president-sales in 1955. Mr. Weller will also act for other divisions in general company matters.

Peter H. Seckel, formerly with Anchor Plastics, appointed general manager of the **Custom Extrusion Div. of Colorite Plastics of New Jersey, Inc.,** 35 Iowa Ave., Paterson 3, N. J. The company manufactures plastic garden hose and extruded products.

John L. Reid appointed sales engineer in the New York district office of **Arthur Colton Co., Div. of Snyder Tool & Engineering Co.,** Detroit manufacturer of production equipment for the plastics, chemical, and pharmaceutical industries.

Fred P. McCarthy named to coordinate the new marketing and distribution program set up by **National Vulcanized Fibre Co.** for its line of Vulcot hampers, wastebaskets, and brush holders.

H. William Peterson, formerly district supervisor in the Middle Atlantic states area, named assistant manager of the **Alcohols and Chem-**

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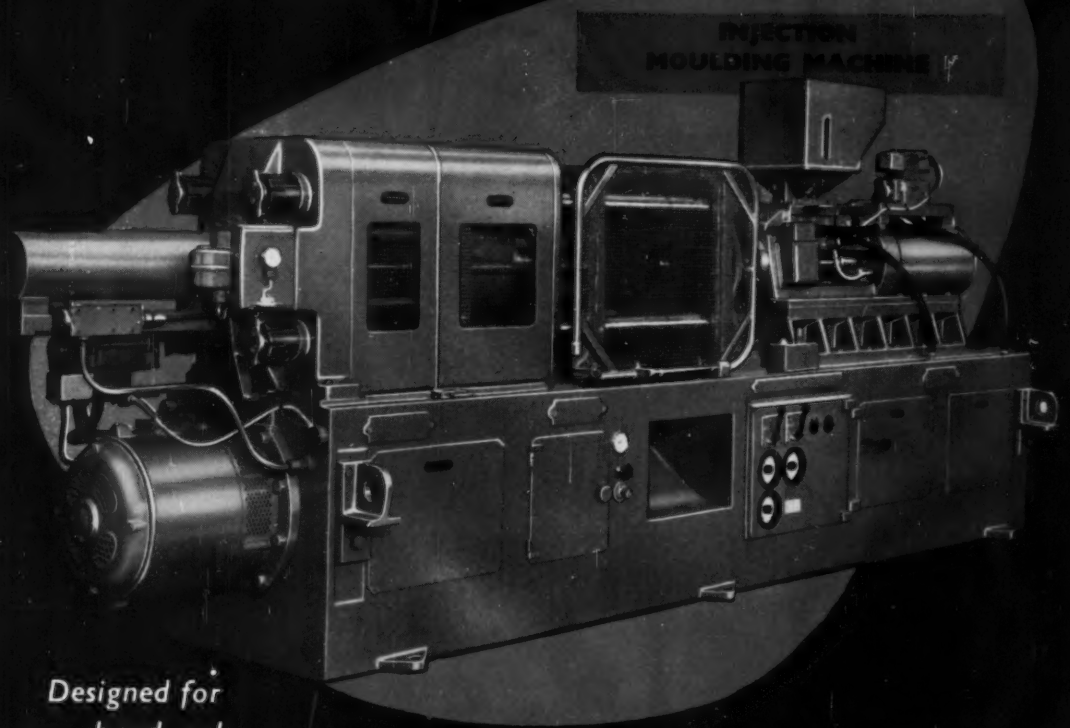

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icals Div. of **Enjay Co., Inc.**, New York, N. Y. The company markets petrochemicals.

Lawrence V. Stapleton, former vice president and manager of Grant Advertising, Inc., appointed director of marketing of **Lippincott & Margulies, Inc.**

Kenneth W. O'Connor named southern Texas regional sales manager of **Tubular Lining Corp.**, Houston processor of plastics linings for oil field tubular goods.

L. K. Homyer, formerly chief engineer of W. R. Chance & Associates, Inc., Arlington, Va., has opened an office as a plastics consultant in the Oporto Malaga Bldg., Newport Beach, Calif.

T. A. McCormack named to the newly created position of technical service manager of **Holland Color & Chemical Co.**, a subsidiary of **National Cylinder Gas Co.**, Holland, Mich.

Frederick E. Lehman named chief mechanical engineer of **Erie Resistor Corp.**, Erie, Pa.

Dorian F. Reid, formerly with Catalin Corp. of America, has joined the Sales Dept. of **Synco Resins, Inc.**, Bethel, Conn.

Robert Lewis, previously in charge of production at Dart Plastics Co., appointed vice president in charge of plant production operations of **Toy Industries, Inc.**, 84 Clifton Pl., Brooklyn 38, N. Y.

Theodore J. Natorski, formerly eastern representative for Danielson Co., now sales manager of **The Danielson Mfg. Co.**, subsidiary of **Nicholson File Co.**, Danielson, Conn.

Samuel Kardon, formerly with Hercules Powder Co., Inc., now on the research and development staff of **Brown-Allen Chemicals, Inc.**, manufacturer of plasticizers.

Gordon Edward Walls named northeast regional sales manager of **Corrulux Div., L.O.F. Glass Fibers Co.**, with offices in New York City.

Vito Abazoris, formerly with Ekco Products Co., named director of engineering of **Santay Corp.**, Chicago plastics manufacturer.

Alfred P. Marone named Los Angeles district manager of **Witco Chemical Co.** He will serve as sales manager for the area and will also be responsible for the operation of the Los Angeles plant.

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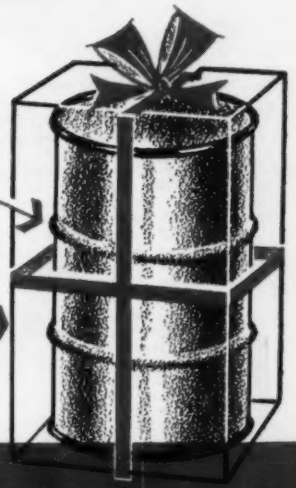

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FOR SALE: Stokes 300 ton and Baldwin-Southwark 200 ton semi-automatic Transfer Molding Presses. Thermal (La Rose) Preheaters. 2500 Ton downstroke 54"x 102". 800 Ton Laminating Press 26"x38". 600 Ton Baldwin 32"x36". 300 Ton multi-opening 40"x40". Elmes 200 ton 28"x26". Farrel 200 ton 20"x80". 200 ton Hobbing Press. D & B 140 ton 36"x36". French Oil 120 ton self-contained. Also Lab Presses to 100 tons. Hydraulic Pumps and Accumulators. Van Dorn 1 oz. Injection Machine. Other sizes to 80 oz. Baker-Perkins and Day jacketed Mixers. Plastic Cutters. Oxford 57" Slitter. Seco 6"x13" and 8"x16" Mills and Calenders. Oil and Elect. Heated Plastic Extruders, lab to 6". Single & Rotary Preform Presses ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th Street, Brooklyn, New York.

STAINLESS STEEL KETTLE: Capacity available for volume Esterification, Sulfonation, Plasticizer, Resin Production. Reply Box 2831, Modern Plastics.

AVAILABLE AT BARGAIN PRICES: 2—Pneumatic Scale Co. Cartoning Units, consisting of Automatic Carton Feeders, Bottom Sealers and Top Sealers. 50 per minute. 4—Scandia Practically New Automatic Cellophane Wrapping Machines. 1—Hayssen Model 10-20 Wrapping Machine, with electric eye. 4—Fitzpatrick Stainless Steel Comminuters with 7½ HP motors and with Vibrator Feeders. 1—Mikro Pulverizer with 40 HP motor and complete auxiliary equipment. 1—J. H. Day mixer with ribbon & wire Agitators and 5 HP motors, 500# cap. 2—J. H. Day Mixers with ribbon and wire Agitators and 20 HP motors measuring 96"x36"x40". Complete details and quotations promptly submitted. Union Standard Equipment Co., 318-322 Lafayette St., New York 12, N. Y.

FOR SALE: 200 oz. HPM induction molder size 1200-P-200 new '53. Excellent; used 1 yr only on short runs; $190,000 replacement value; for making inner door liners for refrigerators. #9 standard upacting geared toggle press 200 tons cap. 32-22-16-12-8-6-4-2 oz. injection molding machines. 50 T. W. Stillman transfer press: new '44, good condition. 4½" Halco rubber extruder: In good condition. Eveready: Box 638; Bridgeport, Conn. EDison 4-9471-2.

FOR SALE: 1-50 ton Dake hydraulic die press model—27-125 size between posts 26 by 54, 16" daylight, ram speed 42-110. Very slightly used—like new. Contact Indianapolis Paper Container Corporation, 217 West 10th Street, Indianapolis, Indiana.

FOR SALE: Injection Molding Machines. 1 Reed Prentice 8 oz. (1947); also 2 De-Mattias, 12/16 oz. 1949 and 1951. All machines in perfect running condition. May be seen in operation in Massachusetts. Service and parts guaranteed on the De-Mattias. Reply Box 2815, Modern Plastics.

FOR SALE: 1-Baker Perkins size 15USE, 100 gal. all stainless double arm Vacuum Mixer; 1-Baker Perkins size 15VUMM, 100 gal. double arm Mixer, 100 HP motor; 6-day 250 and 100 gal. double arm Mixers; 1-Ball & Jewell #1 Rotary Cutter; 2-Two Roll Mills 6"x12"; 6-Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4-Stokes Model "R" single punch Preform presses; 1-Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: 1 M P M 2½" electric extruder; 1 Mitts & Merrill model 10-N-6 pelletizer; 1 Stokes 210 semi-automatic compression molding press; 3 Cumberland #½ granulators, 3 HP; 1 Cumberland 14" rotary chopper; also mixers, mills, grinders, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N. Y.

FOR SALE: Stokes semi automatic 300 ton toggle press with hydraulic power unit and automatic timers . . . $6,500.00. Adamson 250 ton compression press with transfer ram. Hydraulic unit . . . $5,000.00. Columbia Basin Plastics Co., 1900 S.W. Harbor Drive, Portland, Oregon.

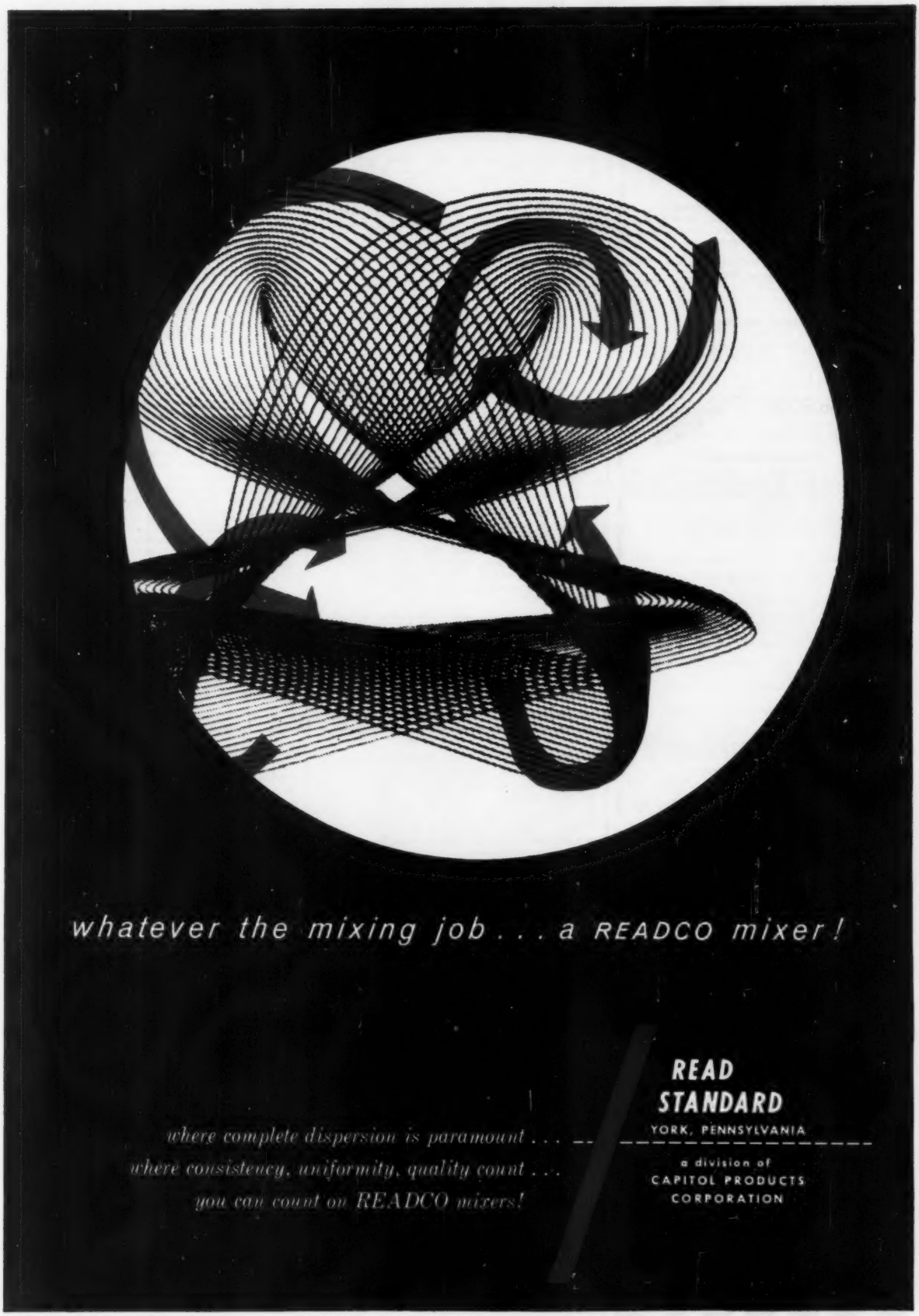
FOR SALE: 64 Oz. Injection Molder with Pre-Plasticizer, mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2 ½L (1949). De Mattia 12 oz. (1946). De Mattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space, steam heated platens. Watson Stillman 300 Ton Semi-Automatic Compression molding Press (1947) self-contained, mold size 34"x27". Watson Stillman 250 Ton 28"x24". Watson Stillman 140 Ton 22"x16". Waterbury Farrel 85 Ton 20"x24". W.F. 63 Ton 15"x15". Laboratory Presses—Elmes 20 Ton 8"x8", others 15 Ton 10"x8" and 10 Ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators. Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 1—4½" Hartig Extruder with 50 H.P. Reliance Drive 1—48" Robbins Sheeting Die with complete take off equipment including shear and stacker. Many other accessories, too numerous to mention all. The above used about 3 weeks. Standard Plastics Company, 442 W. Garfield Blvd., Chicago 9, Ill. Atlantic 5-6300.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2150; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: Steam Platen Presses 2000 ton 60"x46" also 200 ton French Oil Compression Molding Press, 300 ton and 400 ton 36"x36"—Carver Laboratory Presses—other Laboratory Presses up to 75 tons—6"x13" Laboratory Mills—¾" 3000 psi Double Solenoid and Cam operated Control Valves—Extruders—Jacketed Heating Kettles. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N.J. Telephone DEerfield 4-1615.

(*Continued on page* 310)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where complete dispersion is paramount . . .
where consistency, uniformity, quality count . . .
you can count on READCO mixers!
READ STANDARD
YORK, PENNSYLVANIA
a division of
CAPITOL PRODUCTS CORPORATION

(*Continued from page* 308)

PLASTICS MACHINERY

Cutters, Rotary, Plastic

Lab & Small Cutters, ½ HP to 5 HP
Ball & Jewell #1 with 10 HP MD
Ball & Jewell #2 Motor Driven, Extra Knives

Extruders

Hartig 3¼" Elec Htd, 50" barrel, vari-speed drive.
Hartig 4½" Elec. Htd. 96" Barrel, 40 HP. U.S. Vari-Drive.
Stokes—Windsor Model RC-100 Twin Screw 10 HP Vari-Speed Drive

Injection Molding Machines

2 Oz. Van Dorn, Oversize Cylinder, Model H-200
2½ Oz. Van Dorn, Full Automatic, Nylon Cylinder
8 Oz. Reed-Prentice, 20 HP Motor Drive
12 Oz. HPM Model H-300-12
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic

18" x 50" Farrel, Rubber/Plastic, 75 HP MD
20 x 22 x 60 Adamson 125 HP Motor & reducer, floor level

Presses, Molding

15 Ton Baker Fully Automatic
15 Ton Stokes No. 200 D-2 Automatic (10)
30 Ton Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton Francis, 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton Stokes, Semi-Auto., Self Cont.
60 Ton Baldwin-Southwark, 7" Ram x 18" Stroke, 26" x 26" Platen
75 Ton Watson-Stillman Fully Automatic, 20" x 20" Platen 5 HP MD

Presses, Hydraulic

75 Ton French Oil Mill 8" ram x 8" Stroke, 18" R-L x 17" F-B. Both up and down moving.
95 Ton French Oil Mill, 9" Ram x 12" Stroke, 29" R-I x 18" F-B, 3" Pull Backs
100 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
100 Ton Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self Cont.
113 Ton French Oil Mill, 6 Opening, Elec. Htd., Platens 15" x 18"
113 Ton R.D. Wood, 5-Opening Elec. Htd. Platens 14" x 20"
150 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
175 Ton Viceroy Slab-Side 24" x 24", Elec. Htd. Platen with Hand Pump
200 Ton Stokes Semi-Automatic, Power System, Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke, L-R 26½" x F.B. 24½" 7½ HP MD
300 Ton Stokes Semi-Automatic, Power System, Timing Controls
300 Ton Dunning & Boschert 30" x 30" Platen
314 Ton Lake Erie 36" x 36" Semi-Automatic, Push Button Controls 10 HP Pump & Motor
625 Ton Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power

Furnaces and Ovens

Megatherm, 3/60/220, 3 KW, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)

Tablet Machines

Model "E" Stokes, Complete with MD
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer, MD
Model 280-G Stokes Preform Press. 100 Ton Dual Pressure—Late

Mixers

Model "B" Banbury Lab type. Never used
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction

Calenders

6" x 16" Thropp, 3 Roll Chrome Plated, 7½ HP Vari-Speed
2" x 48" American Tool 4 Roll Doubling, Belt Drive
6" x 13" Elec. Htd. 6 Roll Lab Type, 7½ HP MD

Pelletizers

Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery

Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ¼ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses, single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.

683-P Frelinghuysen Ave., Newark, N.J.

What Do You Need? What Have You To Sell?

FOR SALE: Flexograph press—4 Colors —27" width—complete with Rewinder, Drying Equipment, etc. This equipment is practically new—perfect for Polyethylene—Cellophane—etc. Available for immediate delivery. May be seen running in New York City. Reply Box 2826, Modern Plastics.

FOR SALE: 2 oz. Van Dorn 1953, lever; 2 oz. Van Dorn 1952, semi-aut; 2 oz. Reed-Prentice, $1500; 4 oz. Impco, 1951, $5500; 4 oz. Reed-Prentice 1946, $4,000; 4 oz. Lewis, 1953; 4 oz. Moslo, 1956; 4 oz. Pecos w/8 oz. cyls. 1957; several 8 oz. Reed-Prentices. 1946/1951, $5500. up; 8 oz. Watson-Stillman; 8 oz. DeMattia; 8 oz. Lester; 12 oz. DeMattia, Model C, 1953; 12 oz. Reed-Prentice, 1951; 12 oz. Watson-Stillman, Model E; 16 oz. H.P.M.'s, 1948 & 1954; 16 oz. Reed-P; 16/20 oz. R-P, 1956; 20 oz. H.P.M. 1954; 20 oz. Lester 1951; 48 oz. Watson, 1950; 200 oz. H.P.M. 1955; vertical DeMattias. Watsons. Lesters, Impcos; double end tumblers, ovens, grinders, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co. Inc., 2315 Broadway, New York, N.Y. Su 7-1705.

FOR SALE: Ball & Jewell No. 1 Grinder, Cumberland Notch Knife Dicer. Reasonable. 2,000 lb. Capacity Mobilift fork lift truck. Machines can be seen in operation. Blane Corporation, Canton, Massachusetts.

FOR SALE: 20 ounce Lester, New in 1952; 16 ounce H.P.M., New in 1953. Both machines fully equipped. Have been well maintained and are in excellent condition. May be seen in operation. Sterling Plastics Company, 1140 Commerce Avenue, Union, New Jersey.

Machinery and equipment wanted

WANTED: 2½" or 3½" NRM extruder. Give details on drive, year, condition, accessories and price. Reply Box 2816, Modern Plastics.

WANTED: 8 oz.-12 oz.-16 oz.-20 oz.-32 oz. injection molding presses, 1950 or later make. Advise price, condition and serial number of machine. Will consider buying injection molding plant at a midwest location. Reply Box 2817, Modern Plastics.

WANTED: One control panel for M-3 HY-MAC injection molding machine. Would consider complete M-3 HY-MAC machine. Write, wire or call collect. Holiday Mfg. Co., Box 352, telephone DUpont 2-5020, Grand Island, Nebraska.

Materials for sale

FOR SALE: 5000 lbs. of natural reprocessed nylon in pellet form. Contamination free. Price—$.95/lb. Samples furnished by writing. Reply Box 2823, Modern Plastics.

FOR SALE: 5,000 pounds phenolic green mottle, Bakelite 5759, flow 100. Sixteen cents per pound delivered. Columbia Basin Plastics Co., 1900 S.W. Harbor Drive, Portland 1, Oregon.

FOR SALE: "B" stage resin impregnated glass cloth. Polyester and epoxy prepreg seconds 38" wide, various length rolls for use as is, curing into molded parts or chopping into molding compounds. Tacky material has polyethylene interleaver. Approx. 5000 lbs. available. Will consider any reasonable offer. Reply Box 2813, Modern Plastics.

PLASTICIZERS: Standard quality, very low price, 20,000# DIOP, 10,000# each DOP, Dicapryl, Octyl Decyl & Dibutyl Phthalate. Also low-priced mixed plasticizers. Let us know your requirements. Will reprocess your recovered plasticizers. Chemical Affiliates, Inc., 274 Madison Ave., New York 16, N.Y. Tel.: MU-3-2593.

Materials wanted

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940. Rotex Rubber Company, Inc., 1-23 Jabez Street, Newark 5, N.J. MArket 4-4444.

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
Reply Box 2810, Modern Plastics.

VACUUM FORMERS: Sell Us Your Scrap—Best prices paid. Claude P. Bamberger, Inc. One Mount Vernon Street, Ridgefield Park, N. J. Telephone: HUbbard 9-5330.

Molds for sale

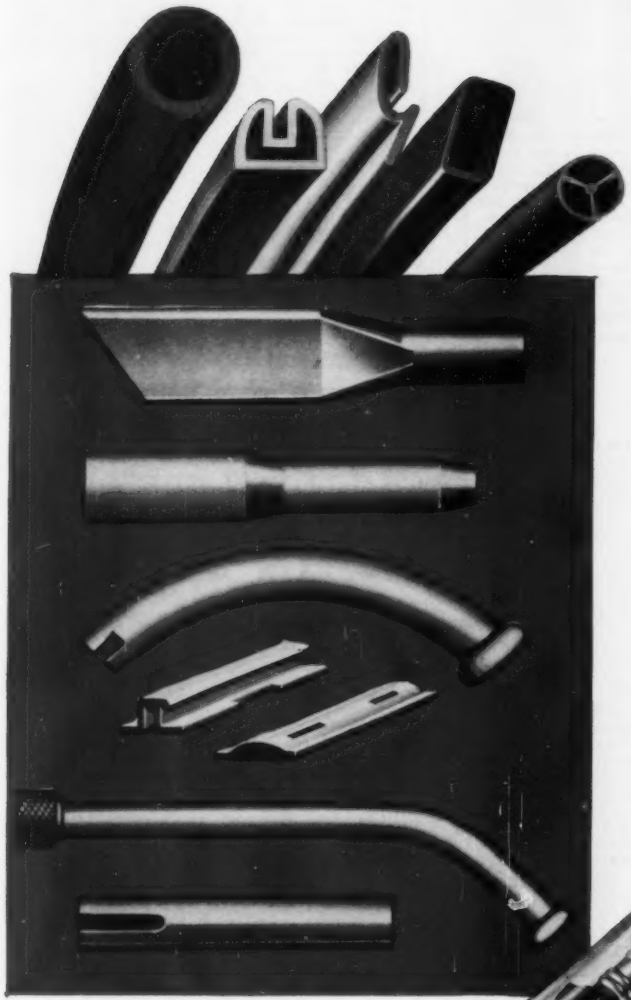
FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 2832, Modern Plastics.

Molds wanted

WANTED: Used molds for plastic pipe fittings. Reply Box 2808, Modern Plastics.

(*Continued on page* 312)

Consult YARDLEY for:



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PROFILES—in color or clear, flexible or rigid to your specifications.

GASKETS—intricate shapes for almost every industrial application.

TUBING—in special shapes or standard, rigid or flexible in diameters from ⅛" to 16".

Whatever the shape or size, Yardley's precision production and know-how assure consistent, uniform accuracy of your extrusions in quantities. Our advanced techniques can save you time and money on exactly the right shape for your specific requirements. Send us your prints for quotation.

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ready for your production line

We shape, flatten, curve, swedge, drill and perform many other fabricating operations to make your plastic parts ready for use. Close tolerance, absolute uniformity, dimensional stability and high-gloss finish are standard production requirements at Yardley.

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This smart package for the protection of spark plugs from dirt and moisture is made of extruded polyethylene tubing. Heat sealing operation is performed automatically on a machine especially designed by Yardley engineers. We may have the solution to your packaging problem. Write us today.

Rigid and Standard Polyethylene
Rigid and Elastomeric Vinyl • Acrylic
Cellulose Acetate • Cellulose Butyrate
Kralastic • Styrene • Nylon • Cycolac
Ethyl Cellulose

Our complete tool and die shop is staffed with skilled technicians. In addition, we maintain a library of over 300 section dies, one of which may fit your product design.

YARDLEY PLASTICS CO.
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YARDLEY MAIL COUPON FOR MORE INFORMATION

Yardley Plastics Co.
142 Parsons Ave., Columbus 15, Ohio

I am interested in learning how you can help us find better ways to solve our extruded plastics problems.

Name_____
Company_____
Street_____
City_____ Zone____ State_____
Position_____

(*Continued from page* 310)

Help wanted

MOLD DESIGN: Assistant Supervisor—Fast growing Chicago-area manufacturer has opportunity for a plastic mold designer who is both young and experienced. Supervise the design of injection, compression and transfer molds; responsible for the initial try-out of all molds. Submit resume, salary requirement to Reply Box 2820, Modern Plastics.

PLASTICS FINISHING SUPERVISOR: Large midwestern plant urgently needs the services of an aggressive, young minded, man to assume full control of its decorating facilities. Experience in spray painting, hot stamping and vacuum metalizing, plus administrative ability is essential. Salary is open and commensurate with ability and experience. Reply Box 2805, Modern Plastics.

REINFORCED PLASTICS Sales Engineer: Large multi-plant corporation has opening in Detroit office for aggressive, personable sales engineer. Experience required in application engineering and sales of pre-mix and pre-form molded parts or related materials to automotive industry or its vendors. Age 25-35. Send complete resume including experience, education, personal history, and salary requirements. Reply Box 2812, Modern Plastics.

CHEMIST: Must be familiar with the production of polyethylene Resin and foam Vinyl compounds. This is an exceptionally good opportunity for the right man. Reply Box 2804, Modern Plastics.

PERSONNEL: Executive—Technical—Sales—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 220 South State, Chicago 4, Ill.—WAbash 2-4800. Call, write or wire—in confidence.

PLASTICS MANAGER (Teflon): College graduate or equivalent to manage Teflon Processing Department for a New England manufacturer. Must have previous Teflon experience. Excellent opportunity with attractive pay scale plus bonus. Apply in writing to Reply Box 2806, Modern Plastics.

PLASTIC EXTRUSION FOREMAN: Opportunity with long established Eastern extruding company, expanding activities in custom shapes and sheet. Experienced in die design, set up and supervision of production. Excellent growth potential and solid future for the right man. Reply Box 2828, Modern Plastics.

WANTED: Responsible individual experienced in plastisol applications. Position consists of supervising a growing department in progressive North Carolina firm. Formulation knowledge not essential. Applicant must be willing to work hard to develop this department. Salary open. Reply Box 2818, Modern Plastics.

POLYVINYL CHLORIDE: Applications Engineer—Opening available for Project Leader in the Technical Service Laboratory. Extrusion experience desirable. This is a challenging job offering good opportunities for personal and professional growth. New laboratory located 40 miles from Boston. Apply: General Manager, Polyvinyl Chloride Department, The Borden Company, 60 Elm Hill Avenue, Leominster, Massachusetts.

EXTRUSION SPECIALIST: Man with knowledge of all phases of the extrusion field, including machine set-up, ability to handle people. Reply Box 2807, Modern Plastics.

ASSISTANT PLANT SUPERINTENDENT: Chicago area corporation has an exceptionally fine position for a man with sheet extrusion and vacuum forming experience. This position is for a man qualified to handle production and personnel. Excellent opportunity for advancement. Salary commensurate with experience and ability. Inquiries treated confidentially. Reply Box 2800, Modern Plastics.

CHEMICAL MARKETING:
Our continuing growth as the leader in our respective field requires the immediate acquisition of a B.S. Chemist and/or Chemical Engineer with the following backgrounds: Petroleum Specialist with two to five years experience in petroleum production or refining. Polymer Specialist—here we seek a man with two to five years broad experience in either plastics or rubber. We offer you, dependent upon your training and/or experience, the responsibility for our marketing developments to the Petroleum, Plastics and Rubber Industries. You will be fortified by having the finest research, test, development, and production facilities at your disposal. The excellent opportunity for advancement and our broad employee benefit program offers an ideal future for you. Please outline, in reasonable detail, your background, education, experience and salary requirements. We will then try to arrange an early meeting, at your convenience, to discuss your potentialities in our rapidly expanding operation. Of course, your inquiry will be kept in absolute confidence. Personnel Manager, Armour Chemical Division, 1355 West 31st Street, Chicago 9, Illinois. Leader in Progressive Fatty Acid Chemistry.

ADHESIVES: We have a client who requires a man with a comprehensive knowledge of adhesives and resins and who can talk and write about them. It is a most unusual and challenging opportunity. Good pay now but much better after you have developed job to full potential. Must live in Cleveland. Some traveling. Give your complete background in confidential letter. Dix & Eaton, Ten-Ten Euclid Bldg., Cleveland 15, Ohio.

SALES REPRESENTATIVE—for vacuum metalizer. Top-notch New York vacuum metalizer desires sales representative calling on proprietory plastic trade. Reply Box 2829, Modern Plastics.

WANTED: Production Executive. Excellent opportunity for two executive type men to take charge of production and maintenance in vinyl plastics inflatable manufacturing plant. Expansion program provides opportunity for advancement. Must be willing to relocate if necessary. Top salary. Reply Box 2803, Modern Plastics.

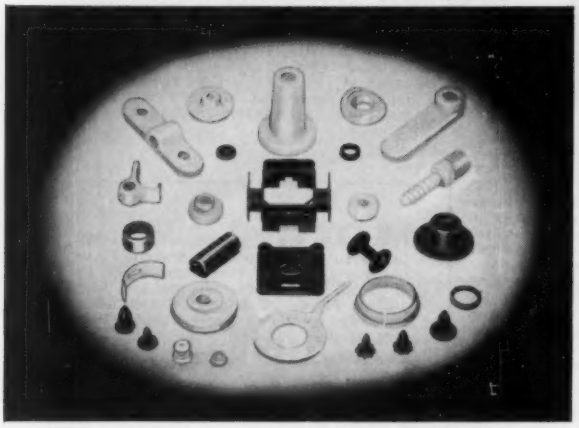
POLYMER OR PLASTICIZER CHEMIST: R & D Position open for synthesis of plasticizers. Fruitful thinking & good analytical reasoning are qualities required. We are seeking a man with experience in epoxidation process or one who has sound foundation in polymerization processes. Excellent fringe benefits provided. Replies will be acknowledged and treated in confidence. Complete resume to: RCI Dev. S.C., 726 Rockefeller St., Elizabeth, N.J.

PLASTICS AND POLYMER RESEARCH—Engineers, Chemists, Physicists. Unusually attractive permanent positions are available to conduct research in the field of plastics and polymer chemistry. Rapidly expanding program in our new, well-equipped, air conditioned laboratories in suburban Delaware Valley area will continue to include the following: polymerization process development for thermoplastics, applications engineering and fundamental studies in the field of reinforced plastics, evaluation of the physical properties of polymers and development of new test methods. We are not necessarily looking for experience in the field, but need top-notch young men with a BS, MS, or PhD who have a sound foundation in Organic Chemistry, Physics or Engineering. Primarily we want creative thinkers with a capacity for sound analytical reasoning. Write full details of training, general background, and salary expected to: Rohm & Haas Company, Dept. OTE-6, 5000 Richmond Street, Philadelphia 37, Pa. Replies will be acknowledged and treated in confidence.

(*Continued on page* 314)

Custom Injection Molding

PARTS OR FINISHED PRODUCTS



Specialists in Thermoplastics

Nylon — Polyethylene — Styrene Copolymers

• A complete service in our plant from designing, engineering, mold making to high speed production with close tolerances on the latest injection molding machines from 4 oz. to 16 oz. capacity.

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Cambridge Surface Pyrometers Help CONGOLEUM-NAIRN Make Better Floor Coverings

In Congoleum-Nairn's Delaware Floor Products Plant, *Cambridge Roll Pyrometers* are used to check the surface temperatures of the polishing roll in the processing of vinyl floor coverings. Proper temperature is a vital factor in maintaining uniform quality of the product. Because they are accurate, quick-acting and rugged instruments, Cambridge Pyrometers are widely used in many industries for routine production purposes as well as in the laboratory.

Send for BULLETIN 1945A

Combination and single purpose Cambridge Pyrometers are described in Bulletin 1945A.

CAMBRIDGE INSTRUMENT CO., INC.

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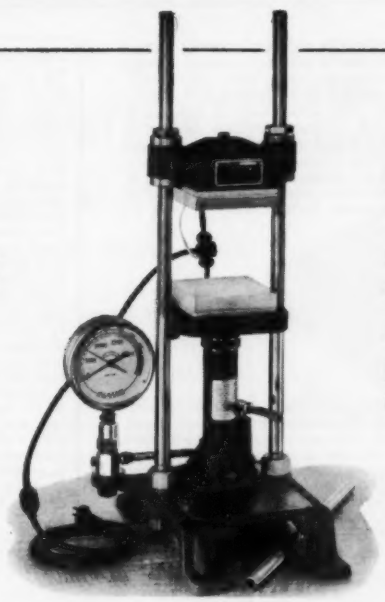
CAMBRIDGE

ROLL NEEDLE MOLD PYROMETERS

SOME OF ITS MANY USES IN

Plastics Laboratories

Testing single-cavity molds.
Molding color samples.
Production of samples.
Plastics instruction and demonstration.
Metallographic mounting.
Metal insert mold tests.
Vulcanizing.
Drawing.
Forming.
Embossing.
Bonding plywood.
Testing tensile properties.
Testing compressive properties.
Testing shear strength.
Flow tests.
Crushing tests.
Breaking tests.
Determining heat cycles.



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The *CARVER LABORATORY PRESS*

...for practical solutions to pressing problems in plastics research and development.

...this dependable, compact press is in use throughout the plastics industry.

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Send catalog, describing Carver Laboratory Press and Standard Accessories.

NAME .....

FIRM .....

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(*Continued from page 312*)

"TEFLON" ROD DISTRIBUTORS—Now being selected and franchised by leading "Teflon" extruder. High-precision, high-quality extruded rod developed and produced exclusively for exacting requirements of precision-machined electronic insulation. (Sizes up to 1", excellent price advantages). Exclusive franchises for Florida, California, Texas and Chicago, Ill. area still open. Sales developed through Company's national advertising, publicity program; descriptive literature available. Submit resume and area covered for prompt reply. Reply Box 2827, Modern Plastics.

SALES REPRESENTATIVES WANTED: with plastic sheet selling experience preferable. Progressive fast-growing manufacturer of acrylic sheeting has openings in lucrative territories. When writing, give selling background, types of accounts, etc. Reply Box 2814, Modern Plastics.

SALESMAN—Material Supplier needs salesman 25-30 of age with compression molding experience. Must have sales personality. Locate within 50 miles New York. Reply Box 2830, Modern Plastics.

SALESMAN: Polyester Resins, experienced, now calling upon Reinforced Plastics Manufacturers using Polyester in bulk. Will cover eastern half of U. S. Private Pilots License preferred. Excellent opportunity for the right man. Write listing experience, salary, etc. Reply Box 2822, Modern Plastics.

SALES TRAINEES: Vacancies for recent college graduates for industrial sales in laminated plastics and vulcanized fibre products. Formal training program. Salary plus commission. Send complete resume to: Manager of Industrial Relations, National Vulcanized Fibre Co., Wilmington 99, Delaware.

Situations wanted

POSITION WANTED: At present technical director AaA-1 company division operating in non-ferrous foil rolling, extrusion, laminating, coating, vacuum metal evaporation. Metals, papers, boards, films, adhesives and colors. Electronics, containers and structural. Military and commercial. Technical and policy. Wish to change; available for one or two days per week on permanent basis. Reply Box 2811, Modern Plastics.

PLASTICS EXECUTIVE: Pioneer in Plastics with 20 years experience. Excellent supplier and customer contact. Capable of helping you to set up a plastics division or assume responsibility in your sales and development program. Under 40, married, expected earnings $15,000 to $20,000. Reply Box 2824, Modern Plastics.

CHIEF CHEMIST-VINYL—BS, MS, Chem engr; 8 yrs experience in development, applications, control of vinyl plastisols, organosols, solutions, latices. Broad knowledge of materials, methods, testing. Aggressive, responsible, inventive. Demonstrated supervisory and administrative abilities. Desire position as Chief Chemist, Tech Director or Asst. Supt. Reply Box 2821, Modern Plastics.

OPPORTUNITY WANTED: B. A. with major in Chemistry. 3 years of experience in production and sales with a large supplier of thermoplastics. Age 26, unmarried, active pilot with extensive travel experience. Desires position with stimulation and opportunity for advancement in sales, service or development in the plastics, aircraft, or associated industries. Reply Box 2801, Modern Plastics.

REINFORCED PLASTICS CONSULTANT: Available for work on product design and development and sales promotion. M.I.T. graduate in engineering and business, with wide experience in reinforced plastics and related materials and processes; including low pressure and matched die molding, plastic tooling, laminating, preforming, premix, etc. Reginald B. Stoops, 445 Park Ave., New York 22, N.Y. Tel. MUrrayhill 8-3800.

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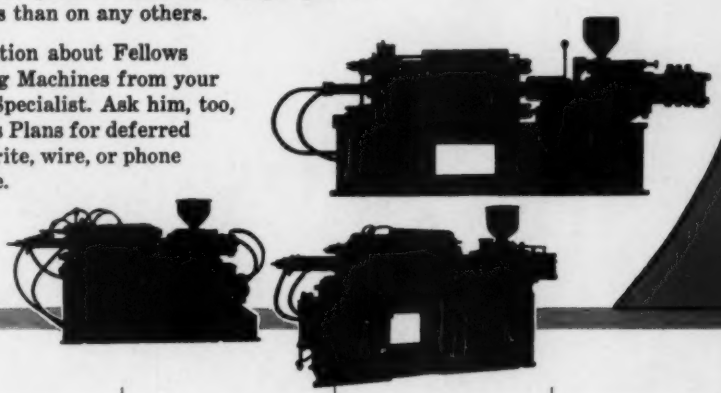

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Rated Capacity	3 oz.	6-9 oz.	12-20 oz.
Max. Mold Size	12" x 17"	15" x 21"	20" x 32"
Mold Locking Force	125 tons	200 tons	350 tons
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H.P.	15	20	40
KW Heater Unit	6	12	20
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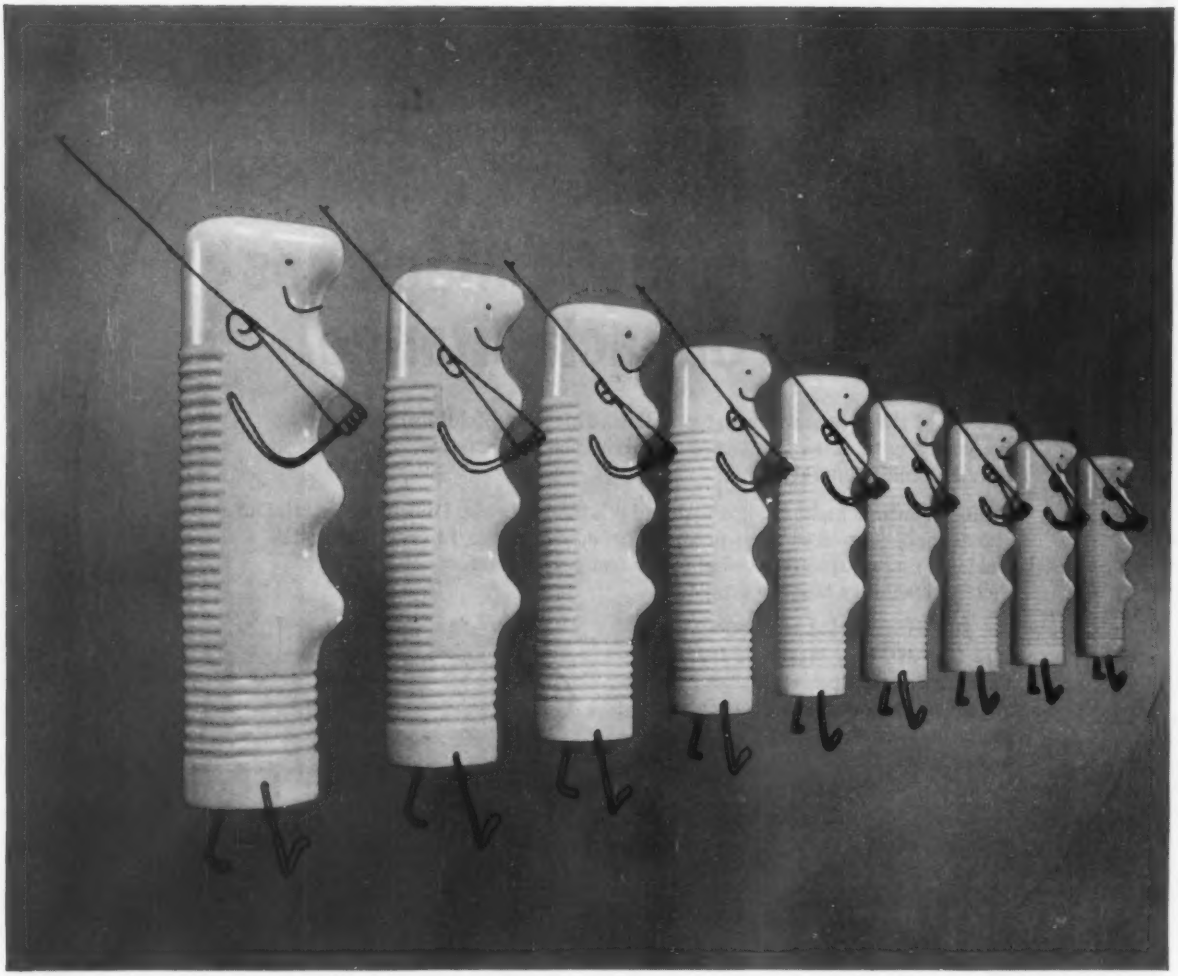

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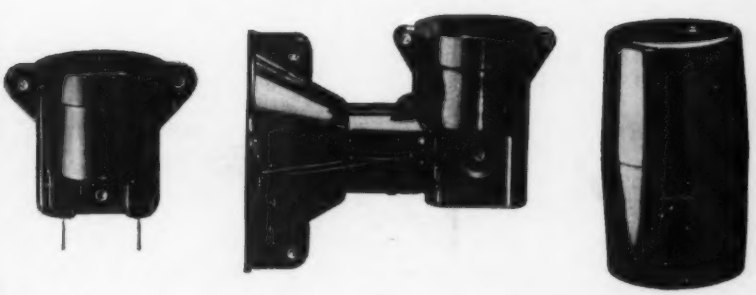
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